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Factory Management *and* Maintenance

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NEXT MONTH

How the works council helped correct high and low wage rates . . . handled the demands of a group seeking special privilege . . . ironed out dissatisfaction when installation of new equipment meant shifting men to other jobs . . . made so-called radicals over into first-class aids to management . . . uncovered good material for supervisory jobs—these are but a few of the good works with which Charles J. Stuart credits employee representation in the concluding half of his "Ten Years with a Works Council."

There's always the question of power drives. In individual cases, physical limitations and manufacturing requirements often dictate the choice between providing each machine with its own motor, and driving in groups from lineshafts. In most plants a combination of both methods is required. What combination of the two is most economical from all standpoints? Robert W. Drake sheds much light on this puzzling question by comparing first and annual costs of each type of drive.

Scheduled also for February—Materials Handling • Metering • Incentives • Motion Study • Standard Costs • Lubrication • Electric Heating • Maintenance Analysis • Gas Correction Factor

COMING

Credit Unions • Plastics • Planning Group Drives • Budgeting for Cost Control • Air Conditioning • Inspection

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FACTORY MANAGEMENT and MAINTENANCE

JANUARY, 1934

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An Experience in Employee Representation

Ten Years With a Works Council

C. J. Stuart

Industrial Engineer, New Haven, Conn.

The 10-year period **began early in 1919, ended early in 1929. The plant in which the works council was operated was one of several plants belonging to a group manufacturing a product that is distributed nationally. In 1929 the parent company concentrated its manufacturing activities in fewer plants, at the same time improving the buildings and the equipment of those plants. Location, age of buildings, and lack of railway siding facilities told against the plant referred to in this article, with the result that it was closed. The works council plan, however, which was already in operation in some of the company's other plants, was installed in still others. Today this plan, substantially as outlined here, is in operation in practically all of this company's plants.—The Author**

EARLY in 1919 I was appointed manager of a large factory, located in a small city where a large proportion of the population was of foreign birth or first generation Americans. In this factory 53 per cent of the employees were of a Southern European race—good workmen, but excitable and of somewhat radical tendencies. Only 20 per cent of the employees were of American parentage. The buildings and much of the equipment were old, and the products were being manufactured at a cost high when compared with the costs of other producers in the same industry.

A quick survey showed that factory costs were high because:

1. The departments were being managed by old-line foremen who did not know modern management.
2. Only 60 per cent of the work was on piecework or other incentive method of wage payment.
3. Foremen were setting wage standards and piece rates, so that earnings in some departments were very much higher, in proportion, than in other departments; even in the same department earnings were out of balance.
4. A large proportion of the work was being done by hand; there was much wasted labor.
5. Production schedules were not being followed between departments.
6. Overhead cost seemed high.
7. There was no proper control of inventories or stores.
8. There were no adequate cost control figures.
9. The inspection system needed improvement.
10. There was evidence of material waste.
11. There was poor layout of departments for continuous flow of work.
12. There were poor working conditions for employees (poorly arranged work places, poor lighting, waiting for work, inadequate locker space and toilet facilities).
13. Distrust between employees and management

Members of the newly organized Employees Representative Council at the Addressograph-Multigraph Corporation, Cleveland, interrupt what may have been a discussion of wages and working conditions to face the camera

existed, as evidenced by labor troubles over the preceding several years.

14. Traditions handed down over 70 years of operation were in effect.

It was seen that, if rapid progress was to be made in correcting these conditions, some drastic changes would have to be made and it would be all important that foremen and all other employees cooperate willingly in making them. This would mean bringing about an interchange of information between employees and management as to what we were planning to do and why, and securing the reactions of employees to the proposed changes and their reasons for such reactions.

The first step taken was to talk over with each foreman the best means of approaching the problem in his department. The foremen were sincere in wanting the factory to be successfully operated and agreed to support the preliminary plans. However, nearly all of them were afraid that the changes might cause labor disturbances, and I could sense that they were not very close to their workers in mutual understanding of each other's and the company's problems.

It became clear that we had to have a more direct way of letting the employees know, before each step was taken, just what we expected to accomplish and how it would affect them, and to get the employee reaction as soon as a move was made.

The works council plan of employee representation seemed the best wherewith to accomplish this aim. After studying the few plans then in use, we decided to use a simple plan of council organization which would be easily understood by the employees, with none of the hocus-pocus or red tape usually put in to impress them.

The plan that we selected provided for the nomination and election of employee representatives to a council, one representative to 50 or 60 employees, at least one from each department.

All officers of the council were to be selected by the employee representatives, from their number, at their first meeting.

The chairman of the council was to appoint each member to a standing committee, to consider certain matters that would come before the council, such as working conditions, rates and earnings, safety.

Each committee was to elect its own chairman, and the chairman of the council with the chairmen of these committees were to constitute an executive committee to guide the council.

The management was to appoint certain representatives to sit in at every regular council meeting, and at regular committee meetings, to present matters from the management, to get the employees' viewpoint, and to answer their questions.

The employees' representatives could, if they desired, call a special meeting of the whole council, or of any committee, with no management representative present.

The sequence to be followed, in settling any matter that might come up from the employees, was as follows:

1. The departmental employee representative was to deal directly with his foreman.

2. The departmental employee representative was to present the matter at the next regular meeting of the proper committee, if the foreman could not settle it.

3. The committee was to present the matter to the executive committee, if the proper committee could not reach a decision satisfactory to the complainant.

4. The executive committee was to present the matter to the factory manager for his decision, if the executive committee could not settle it.

5. If the decision of the factory manager was not satisfactory, the case was to be taken up at a meeting of the whole council; if not satisfactorily settled there, it was to be settled by arbitration.

[Note: In ten years of council operation, every question which arose was satisfactorily settled before it passed stage four. Smaller matters were settled by the foremen; practically all others were cleared up in the regular committee meetings.]

This plan was presented first at the weekly foremen's meeting for their discussion. The first reaction was that the foremen felt that their prestige might be reduced if they were not the only point of contact between the employees and the management.

They did not see how we could sell the employees on the council plan and were afraid that the employees would think that the management was trying to put something over on them. They also thought that the employees would use the council continually to bring up wages and rates.

We explained to the foremen that, under the proposed council plan, provision was made for them to have the first crack at satisfactorily settling each thing that might come up; that any foreman big enough for his job, and square in his dealings with both employees and company, had nothing to fear concerning loss of prestige.

They were told that we would find a way to sell the council plan to the employees. What if they did bring up wage and rate questions in the council? These questions would be discussed anyway, and where better than in a council meeting, in front of management representatives, where something could be done about it?

During this time the labor unions were putting on a drive to increase membership, and the industry of which we were a part, and which had always operated under the American plan, or on an open shop basis, was one of those selected for organizing. They had already succeeded in organizing several factories in the industry and had begun a drive down into our territory.

From my past experience I knew that if we had to deal with a union delegate, who would know nothing of our special conditions, our progress toward correcting conditions in our plant, without a lot of labor trouble, would be very slow. We knew that our plans would ultimately benefit the employees, but we also knew that changes which altered work habits would lead to a lot of problems that would need close contacts between employees and management to iron them out satisfactorily. Since the foremen were at least partially sold on the council plan, we decided to put it in at once.

Our personnel director, who had been picked for his job because he was an enthusiast for closer relations between employees and management, and who rather leaned to the employees' viewpoint, was given the job of installing the plan. After going over it with each foreman, he came to me and said that some of the foremen were still lukewarm on the council idea; that he was not confident that they could present it to their employees satisfactorily; and that he would like to have me, as manager, present the plan to all employees.

31 New England concerns, out of 400 contributing to a recent survey, adopted new employee-representation plans between June and October, 1933—a 60 per cent increase

This seemed like a good piece of psychology, because probably no manager in the plant had ever gone directly to all the employees on any question. It would at least insure the plan of an attentive hearing and plenty of succeeding discussion. I decided to speak to groups of not over 100 employees, which meant 17 to 20 presentations. This was accomplished on two consecutive days with about 30 minutes to a presentation.

The talk was a frank discussion of the situation, outlining the sad position of a high-cost factory in a highly competitive industry; acknowledging that there was opportunity for much improvement in working conditions; admitting that the cost of living was increasing (this was the period of rapidly rising living costs which reached an all-time peak in 1920) and that wages would have to rise to offset the increased cost of living; pointing out that if we were to raise wages we must do many things to bring down the cost of operation in other ways.

I explained that the management wanted to pay as high a wage as possible and to improve the working conditions for the employees, but in return the employees would have to cooperate closely with the management; that in such a large organization there was no way to get this close cooperation unless the management could sit down with representatives of the employees to talk over conditions and changes as they came up; that for this to be done the employees would need a plan whereby they could regularly meet with the management to discuss their respective problems in a friendly manner; that for this purpose the management had drawn up a temporary council plan to aid them in the first election and organization of representatives, but that this plan was flexible, so that the council could make any changes that might seeme desirable after they had studied it.

They were frankly told that outsiders might tell them that this was a company union, made to order by the company to present to them. They were assured that this was not so; that the council plan was to protect their interests; that if they would nominate and elect to the council the person whom they could best trust to look after their interests, the management guaranteed that the representative would be free to bring up and have discussed in the council meetings anything that they might consider in the employees' interest, without in any way affecting their position with the company; that the management would be frank and fair in its dealings with the council, and inform them in advance of plans which would affect the employees, and would give careful consideration to any matters brought before the council.

They were told that the personnel director would help get the plan under way and give every assistance in operating the council, but that the employees must feel the council was theirs, to alter or drop altogether if the

majority, at any time, felt that it was in the employees' interest to do so.

It was explained that at the first election the foreman in each group would appoint employees to collect and count the votes, but that the employees in any group could protest such appointment, and that in future elections the employee representatives in the council would select their own committee for this purpose.

Two days after these talks nominees were voted for, and two days later elections were held, the voting being confined to the two nominees in each group who had received the largest number of votes in the primary election. All of the voting was done by secret ballot. A subsequent totaling of ballots showed that practically all employees had taken part in the election.

What type of employees had been elected to the council? More than half of the employees were women, and we found that slightly over half of the representatives were women. Contrary to the expectations of some of the foremen, the employees had elected to the council only three members who were at all radical, and one of them was from a group of men considered radical in their viewpoint. The rest of the representatives were good workmen, most of them a long time with the company, who could be expected to give fair and unbiased thought to anything that might come up.

After the employee representatives had met and elected officers and appointed committees, the first meeting of the council as a whole was held. I attended, as did all department heads.

I told them that we hoped they would discuss anything with the management representatives as freely as they would among themselves; that such problems were mutual; and that the company wanted the factory known in the community as a good place in which to work.

I said that the foremen were the management's representatives and would be held responsible for the successful operation of their departments, and that we hoped that the employee representatives would have enough confidence in their foremen to take up their problems with them; but that if anything came up which the foremen could not or would not handle satisfactorily, then it should be presented to the proper council committee to be settled. And I promised that, in so far as it could, the management would take prompt action on matters brought up through the council.

One of the first promising things that came out of the council's organization was the immediate activity of the foremen to get departmental conditions of long standing corrected, so that employees would not have to bring them to the management's attention through the council.

The foremen's meetings became alive with discussion of things that employee representatives were bringing to the foremen's attention.

The complaint which stood out from all others was the breaking down of production schedules and service between departments. This was delaying employees in their work and directly affecting the earnings and quality of work of those on piecework and directly increasing the cost of operations due to the large number of employees on day work at that time. This concentrated attention on maintaining production schedules in each department and on the delivery system between departments, so that, in a short time, this situation was much improved.

The council plan had been in operation but a short time when one of the foremen reported that an employee representative in his department had informed him that a few employees in the factory were trying to create sentiment against the council, and were advocating joining the union. He also had the information that a trucker in the inside trucking department, who had not been long in the employ of our company, seemed to be the one who was pushing this activity. He said that the employee representative gave him this information only because the representative felt that there was something in the council plan and he would like to see it given a fair trial.

The trucker was asked to report to my office that afternoon. He was an intelligent-looking young fellow and said at once that he knew why I had sent for him, admitted that he was a paid organizer for the union, but said that he could not make any headway in organizing our plant. He said that the employees felt that the management meant to give them a square deal and believed that the works council gave them a much better contact with the management than an outside labor union could. Besides, they did not have to pay monthly dues.

He was told that we did not discriminate against union members in our plant and that he could go right on working at his trucking job if he would give up his paid job with the union, but he chose to get through as he was getting two wages while organizing for the union. That was the only attempt to unionize the factory in ten years of works council operation.

[The conclusion of this article will be published next month. It will tell of employee reaction to changing jobs from daywork to piecework, making time studies, evening up wages, introducing cost-cutting machinery. It will present the principal questions that have been asked of the author and will give his candid answers.—Ed.]

▼ ▼ ▼

In a survey of employee relations completed in December by the National Industrial Conference Board, reports from 3,314 manufacturing and mining concerns which employ 2,585,740 wage-earners (about one-fourth of the total for these industries) indicate that 45.7 per cent of the workers deal with their employers individually, 45 per cent through plans of employee representation, and 9.3 per cent through organized labor unions. Of the employee-representation plans and labor-union agreements reported, 61.3 and 41.8 per cent, respectively, had been adopted since the passage of the Recovery Act. Actual figures were 400 employee-representation plans and 174 labor-union agreements

How Electron Tube Devices Operate

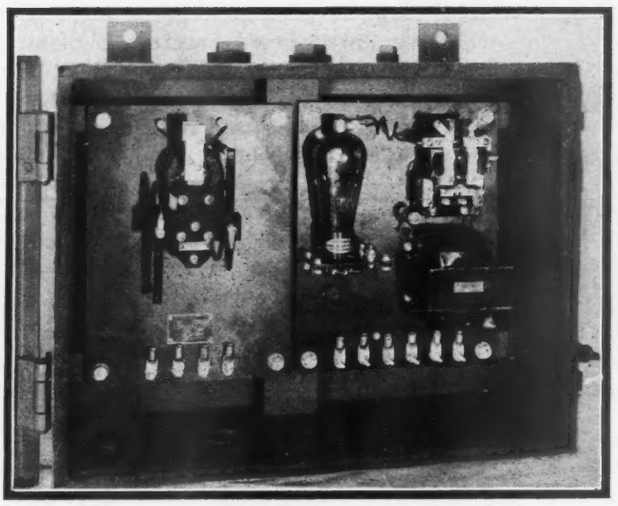


Figure 1. Simple amplifying unit for use with phototube control

L. R. Harness

Industrial Department, Control Section
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

INDUSTRY has had several years of experience in the application of electron tube devices to the solution of many control and regulation problems. The fact that such devices often provide the simplest and most reliable, sometimes the only, means of solving these problems has been established beyond the need of discussion here. Just how these devices operate may not be so well understood by those who use them.

In the simplest application of an electron tube device where only amplification of the magnitude of the controlling impulse is required, the duration being satisfactory for the operation to be controlled, an outfit such as shown in Figure 1 may be used. Since the activating impulse is of adequate duration, only a.c. circuits are used, in contrast to d.c. circuits, which will be discussed later.

From Figure 2, showing a simple circuit for this piece of apparatus, it will be seen that a power transformer is used to obtain the different voltages required for operation. The phototube and its series resistor are supplied with 100 volts. The phototube itself acts as a variable resistor, since its resistance is nearly infinite when it is in the dark and decreases to a few megohms when illuminated. When the resistance of the phototube changes, the phase relationship of the voltage impressed upon the grid of the Grid-Glow tube is shifted with respect to that impressed upon the anode. Figure 3 shows graphically the effect of this phase-shift. Although the current that flows in the phototube is very small, being on the order of 5 microamp. (millionths of an ampere), it flows through the resistance of 4 megohms, and the consequent voltage of 20 volts is of sufficient magnitude to accomplish its purpose.

Turning now to the Grid-Glow tube, it is seen, Figure 2, that a voltage of 200 volts is impressed upon it and its accompanying load, which may be a magnetic device, such as a contactor or solenoid, or a resistance device, such as a heater element. The current carried by the Grid-Glow tube may be of any desired value up to 4 amp., since tubes of this rating may be controlled directly by a phototube. It will be seen, then, that the device can be operated by interception of a light beam, which act in itself requires no expenditure of energy. The first step in accomplishing the necessary magnification of energy is in the phototube where 100 microwatts (millionths of a watt) are controlled; the next step is in the Grid-Glow tube, where as much as 1 kw. may be controlled; the last step may be a contactor through which many kilowatts may be controlled.

If desired, a pair of contacts may be substituted for the phototube. In this case the contacts represent an infinite resistance when open and approach zero resistance when closed. It is evident, then, that satisfactory operation will be obtained with contacts. Also, since a change of resistance is all that is required, operation can be obtained with conducting or semi-conducting mate-

rials, either liquid or solid, and either by having them in contact with a pair of electrodes or by remaining in contact but changing their state so that they are rendered more conductive.

In the case explained above, it was assumed that the light beam was either entirely established or intercepted. There are applications, however, where the light varies gradually and where it is necessary for the equipment to operate from a given amount of light; in other words, the equipment must be capable of calibration. Such duty is encountered in the heat-treatment of steel, where the phototube is called upon to measure the temperature of the steel by the amount of light emitted. Unless a very high degree of precision is required, the same class of equipment described above may be used. The sensitivity adjustment is used to secure operation at the desired temperature and aids the phototube in shifting the phase of the grid voltage. When the adjustment is given a sensitive setting, only a small amount of light is required to enable the phototube to "trigger" the Grid-Glow tube, whereas a less sensitive setting requires a greater amount of light (higher temperature) to trigger the tube.

In many applications the activating impulse, such as a light beam, is of such brief duration that no control function can be performed without means of extending its length in some manner. Besides being brief, the impulse usually is of small magnitude; so it must be increased in both magnitude and duration. The Grid-Glow tube is capable of performing both functions. Increasing the duration of the control impulse is brought about by using direct current in the anode circuit of the

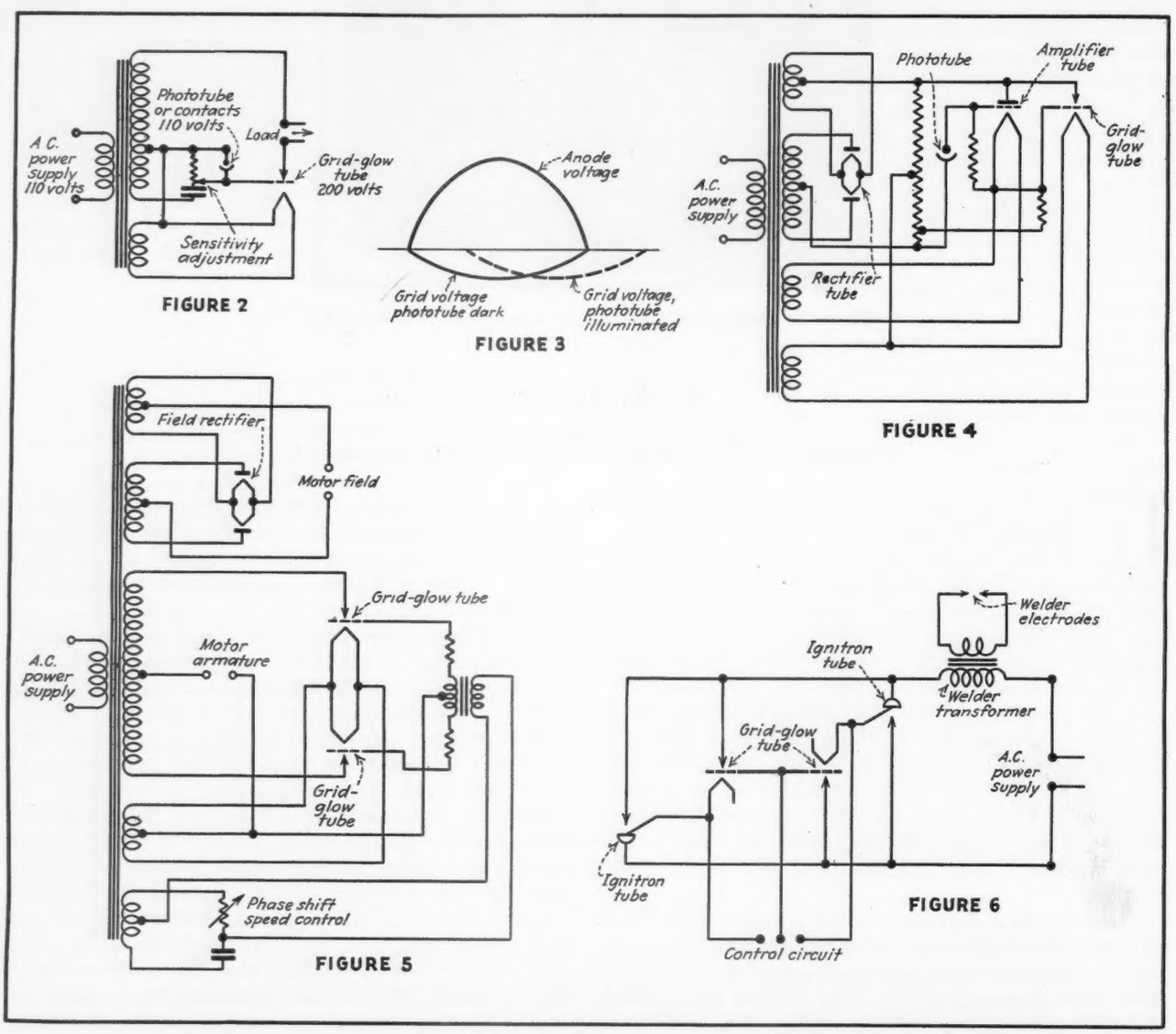


FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

FIGURE 6

Figure 2. The phototube shifts the phase of the Grid-Glow tube, permitting it to pass current to the load, which may be a contactor, solenoid, or other device. Figure 3. Magnitude and phase relationship of the grid voltage with respect to the anode voltage, when the phototube is dark, is such that no anode current will flow. When the phototube is illuminated, the grid voltage is shifted so that none is present at the beginning of the half-cycle of anode voltage, thus permitting the tube to break down and conduct current. Figure 4. An amplifier tube is used to increase the sensitivity of the equipment, with a rectifier tube to permit locking-in on impulses of very short duration. Figure 5. Grid-Glow tubes are used to control the armature voltage of a d.c. motor. The field is supplied through rectifier tubes. Figure 6. Currents as high as 1,500 amp. are supplied by Grid-Glow-controlled Ignitron tubes to the welder transformer, which steps the current up to 60,000 amperes

tube. This does not mean that the equipment must be operated from a d.c. power supply; it is necessary merely to incorporate a rectifier of either the electronic type or the Rectox type in the circuit.

After the grid permits the current in the anode circuit to flow, it will continue to flow until interrupted by some means external to the tube. When alternating current is used, the current is interrupted each half-cycle when it reaches the zero axis; therefore, direct current must be used if that characteristic of the tube which enables it to sustain the impulse is to be utilized. Hence, with direct current applied to the anode of the Grid-Glow tube, it becomes at once a high-speed, lock-in control device. Since it is capable of locking-in on an impulse of only 1/5,000-sec. duration, it makes possible the fastest known control device of this nature. That is one of the reasons why electron tube devices may be applied safely in many places where mechanical, electro-mechanical, or electrical devices cannot possibly be used.

The circuit diagram of a device which is provided with a rectifier for supplying direct current to the Grid-Glow tube to permit it to lock-in on instantaneous impulses is shown in Figure 4. Here again a phototube, a pair of contacts, or a change in resistance may be used to operate the equipment. Instead of operating the Grid-Glow tube directly from the phototube, however, an amplifier tube is used to increase the energy output from the phototube. Since the equipment is designed to operate in high-speed applications, the available time for each step in the sequence of operations is on the order of a few microseconds (millionths of a second). In this exceedingly brief length of time the phototube alone may not have sufficient energy to shift the phase of the grid voltage of the Grid-Glow tube; hence the amplifier tube is employed. The current carried by the amplifier tube is 5 milliamp (thousandths of an ampere) or a thousand times that of the phototube. This current flowing through the resistor of 10,000 ohms gives a voltage of 50 volts for faster action.

Because of the lock-in characteristic of the tube, mentioned above, it is necessary to interrupt the flow of current by some means external to the tube. For example, if the tube is used to operate a solenoid, the latter may be equipped with a limit switch to interrupt its own operating current at the end of its travel. Some applications require automatic interruption of the Grid-Glow tube current after a predetermined time. It is not difficult to provide a simple timing circuit which can easily be adjusted to give the required duration of current flow.

Another interesting application of Grid-Glow tubes is that of controlling the speed of d.c. motors. As shown in Figure 5, a.c. power is supplied to the transformer and then to the tubes. Here the current is rectified and controlled at the same time. A device similar to that used as a volume control on a radio set is used to control the phase relationship of the grid voltage, which regulates the amount of current passed by the tubes and, consequently, the amount of power supplied to the armature of the motor. Its speed is, of course, a function of the amount of power supplied to the armature.

In order to eliminate the effects of line-voltage variation upon the speed of the motor, it is desirable to supply the field from the same source. Rectifier tubes are

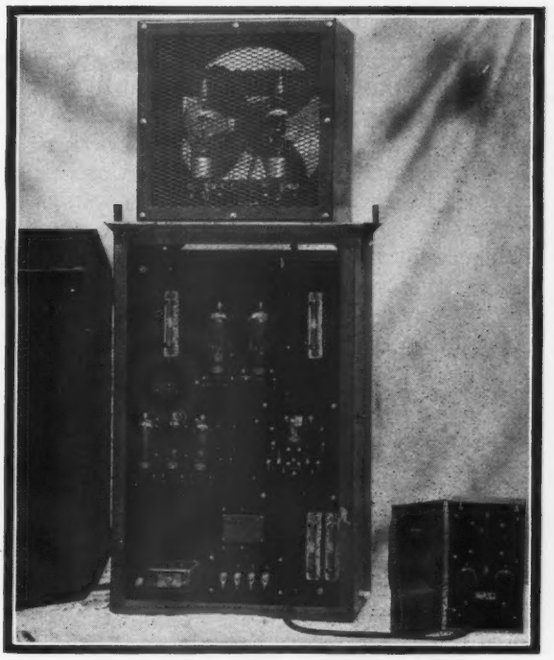


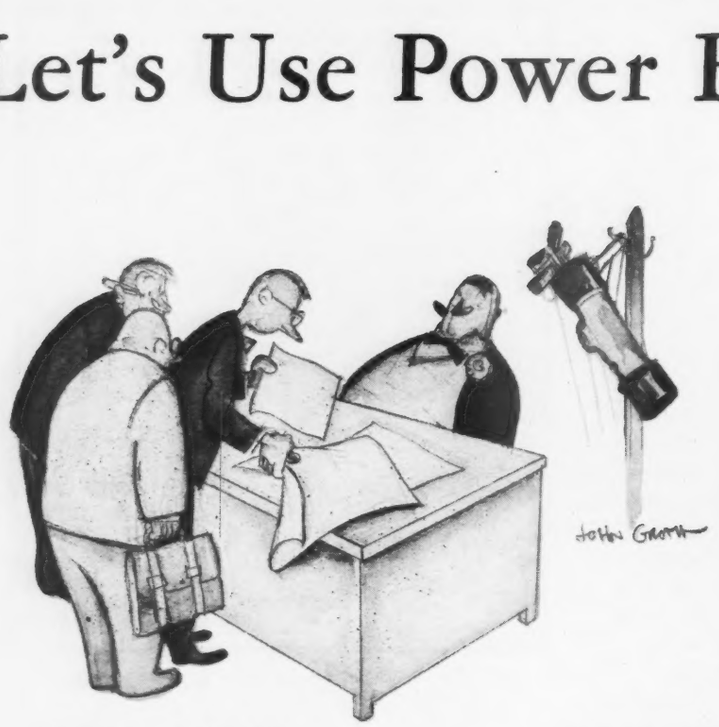
Figure 7. Electron tube timer for spot welding

used to obtain the direct current, two tubes being used to obtain full-wave rectification. Armature currents as high as 50 amp. are readily controlled by this equipment. In addition to motor control, the equipment may be used for any application where it is necessary to obtain a controllable amount of d.c. power from an a.c. source. The voltage may be stepped up by the transformer so that a d.c. output as high as 5,000 volts may be obtained.

Figure 6 shows the circuit diagram of the latest type of electronic welding timer, illustrated in Figure 7. The heart of the equipment consists of the two Ignitron tubes in the screened enclosure at the top of the cabinet. These tubes are similar in performance to Grid-Glow tubes, but are capable of carrying instantaneous currents as high as 1,500 amp., although their physical size is no greater than that of a 10-amp. tube of more conventional design, which would have an instantaneous current rating of not more than 25 amperes. These tubes, which supply the current to the welding transformer, are controlled by the two Grid-Glow tubes shown directly below them. For the sake of simplicity the adjusting circuit is not shown in Figure 5, but the tubes for this circuit are the three Grid-Glow tubes at the left of the cabinet. The small cabinet at the right houses the control unit. By means of this timing and control circuit, the Ignitron tubes are caused to pass any desired number of cycles or fractions of cycles of welding current so that precise control of the weld is obtained. A transformer is used to step up the current from 1,500 amp. to 60,000 amp. for welding.

In all applications, care must be taken to make sure that the demands of the application are met by the capabilities of the equipment. If a photo-electronic device is used, care must be taken to make certain that the light source selected can produce a beam of sufficient intensity and proper characteristics for the phototube, that the phototube circuit has adequate sensitivity, and that the output rating of the equipment is suitable for the power requirements of the application.

Let's Use Power Brains



Experts . . . make their reports to stuffed shirts

This is a tirade. The author admits it cheerfully. If at times he gets right down to the level of the common scold, remember that an occasional raking over the coals is good for soul and pocket-book. And if you're sure it isn't your plant he's talking about, anyway, why then more power to you! — The Editors

Philip W. Swain
Editor, POWER

AMERICA is a great country. American industrialists are a great lot. Everything in all our factories is wonderful. Supermen run them. Master minds coordinate millions of details gathered by experts, consider the infinite combinations, weigh investments against returns, decide on the one best course, order immediate action, get it, pile up the maximum in dividends.

But you can tell the rest of that story to your grandmother.

A more reliable outline of industrial America would read like this. America is a great country. American industrialists are a great lot—out in the lot. There are some wonderful machines in the factories. People are hired to run them, Experts, near experts, and ignoramuses study details. They make their reports to stuffed shirts who either reject the whole lot or pick the recommendations of the men who know least about the subject in hand. Then everyone goes out to play golf.

Meanwhile machines run until they bust, whereupon new ones are bought on the recommendation of the first salesman who crashes the office gate.

A pretty sour picture and not quite fair. But not so far off if I can judge the whole by the part I see most—power. Assuming that industrial executives are running factories to make money, why in the name of all that is holy do they keep on throwing it away in shovelfuls?

Why do plants by the thousand buy power when they should be making it? And why do other thousands make power when they should be buying it? Why do owners and managers keep on guessing wrong when the technique of a correct answer is one of the best established in the whole engineering field—when, for a moderate fee, they can buy an honest and intelligent answer?

Why do they insist on proceeding without any advice whatever, or rejecting what they pay for? And why, if they won't buy power advice they are willing to follow, don't they learn something about the subject with which they persist in dealing?

The industrial world is full of fool ideas about power. I know places where they keep a minute check on every three-cent postage stamp floating around the office and then pile $10,000 worth of coal in the yard with no accounting whatever except the coal company's bill. I know places where a fireman's ability is judged by the size of his biceps—presumably because it will make him happy to shovel away the plant's money. A man a little lazier in the arm and smarter in the head might be interested in working 10 per cent less by firing that much less coal.

A lot of executives have an idea that the art of coal conservation consists in putting a barbed-wire fence around the pile to keep old women from carting it off in their aprons. Fence once installed, they O.K. coal bills with a smile.

Coal buying, too, is a simple art in their opinion, calling only for the wiles of the pawnbroker. "Insist on good coal and then beat the coal company down a few cents a ton on price." When some of these men finish their bargaining they are still about a dollar a ton worse off than if they knew how to locate a "bad" coal (hence a cheap coal) that would be *good* in *their* plant with proper equipment to burn it. One plant on Long Island saved $16,000 a year by changing from "good" coal to "bad."

Boilers make steam, it is commonly understood. Steam has a cost, whether you know it or not. It is elementary common sense to put a meter on that steam to see how much you are making, and to install another measuring device to weigh the coal delivered to the boiler. How

else are you going to know how much money you are burning up to make a thousand pounds of steam? It is a waste of time to kick at the leather bill in a shoe factory until you know how many pairs of shoes you are making.

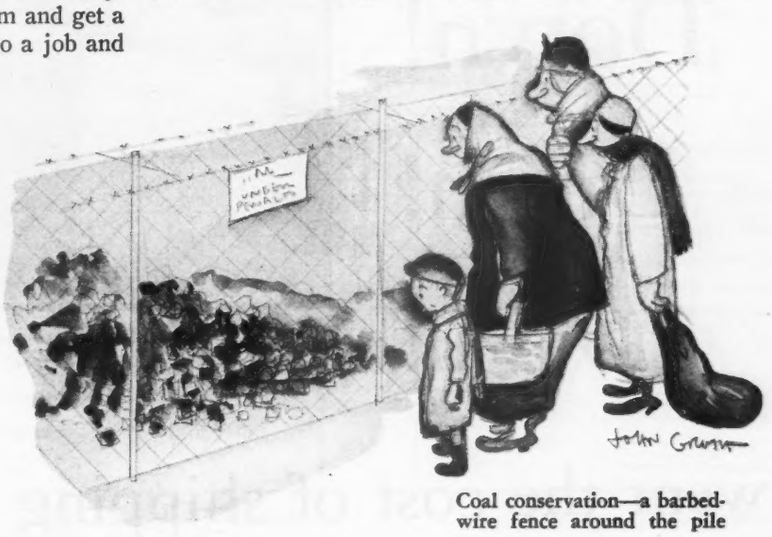
Don't tell the power engineer, "You can't buy that," or "You can't have this." Try a little common sense. Give him a department to run. Let him put in the devices needed to measure what he turns out as well as what he spends. Let him decide what he needs to do his job and *then hold him absolutely accountable for unit costs only.* If you lack confidence in the engineer, fire him and get a man you can trust; but don't tell a man to do a job and then pile ties on his track.

If the engineer has any sense and is chalked up for the total cost (including fixed charges) of each thousand pounds of steam produced and every kilowatt-hour of power delivered, do you suppose he will ask you for a boiler meter or a new stoker if he isn't pretty sure it will cut the unit cost of steam and power? If he can do it, why throttle a big saving in the name of "economy"?

How much thought have you given to possible savings in the use of power and steam? Think what would happen to the gas consumption on your home street if all of the families pulled out their gas meters and if each paid a fixed yearly fraction of the total bill for the street. Think what must now be happening in your own factory if you don't meter steam and electricity separately to each important department, and bill each for its use. By doing this, and nothing more, many factories have cut power and steam consumption 20 to 40 per cent.

Do you still cling to the obsolete notion that the matter of buying or making your own electricity can be decided without consideration of your demands for process and heating steam? If so, forget it and you will probably save several times your salary the first year. Ask your engineer how completely your power plant utilizes the possibilities of getting "byproduct" power from such steam. Ask him how many thousands or tens of thousands of dollars he can save you yearly by a better hook-up. And ask him to estimate the investment needed to make this saving. If he can't do all this, he is a dead loss as a power engineer.

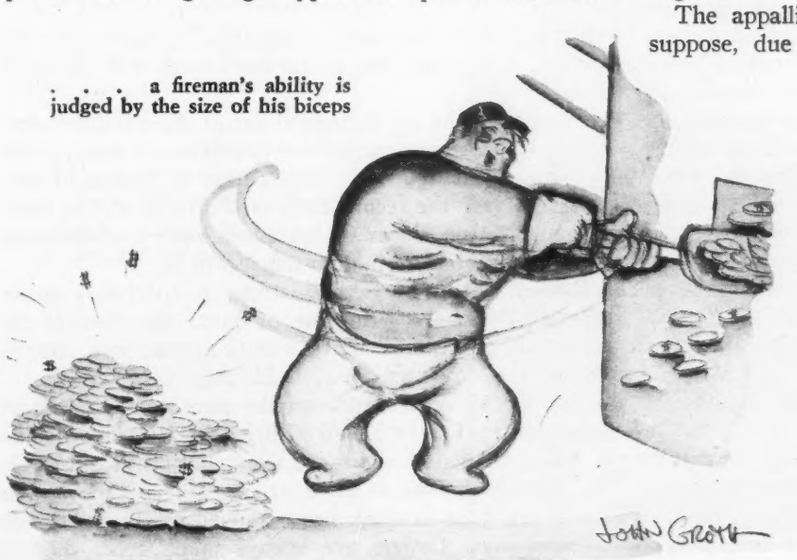
Ask him also to set up the most economical local-power-generation-combination against the best combination of steam generation and power purchase (part or total) he can devise. There are many combinations. It may be cheaper to buy all power than to make it the way you are now running. Local generation with a scientific hook-up of heating steam and byproduct power may be better than either. And, again, a combination of generation during periods when heating steam demands are high, with purchase or part purchase at other times, may be best of all.



Coal conservation—a barbed-wire fence around the pile

Get your power engineer busy on this job. More than likely he has already given it a lot of thought and has stayed awake nights figuring how to crash your utter indifference to the thousands of dollars he is trying to hand you on a silver platter. If you can't quite believe the savings promised, spend a few hundred dollars to have the whole layout checked by a competent consulting engineer.

The appalling power wastes in many plants are, I suppose, due largely to that familiarity which breeds contempt. The men at the top see, smell, and touch power and steam all day long. They *think* they understand the power problem—but they don't because they never took the trouble to study its ABC's. Yet every bit of brains and knowledge needed to solve the power-cost problem is available at trivial cost. Many a plant could cut power and steam costs 20 per cent or more by intelligent handling, and in many a plant today this would add more than 20 per cent to the narrow ribbon of net profits.



. . . a fireman's ability is judged by the size of his biceps

Down! Down! Down!

"Forward stock" consists of small stocks of active items available for use by order pickers without requisition or record

went the cost of shipping small orders

Yours will go down, too, if you will find a way to adapt the Bauer & Black "forward-stock" plan to your own shipping job. It avoids individual records of thousands of small transactions, makes shipping seem simple

THE STOCKROOM is an important element in the production plan of Bauer & Black, manufacturers of surgical dressings and supplies. The typical customer's order calls for a variety of standard items in relatively small quantities. It is to avoid keeping individual records of these thousands of small transactions that the company has adopted a "forward-stock" system. The forward stock contains normally from 10 to 15 per cent of the total inventory, and consists of small stocks of each of the active items, carried in bins and shelves at a convenient central location for shipping.

No requisition or record is required by order pickers in drawing from this forward stock, although any demands on the reserve stock must be met by requisition in the usual fashion. Thus the company has accurately balanced records on the reserve stock, which constitutes about 85 to 90 per cent of the total inventory, while avoiding the vast amount of clerical labor which would be required were small orders filled by requisition.

Order pickers have the choice of filling from forward stock or requisitioning from reserve stock; the latter is used chiefly when unbroken cases are called for.

In each of the piles on the forward-stock shelves, a marker is inserted at the minimum or order point. When this minimum is reached, the marker is removed and sent to the stockkeeper in charge, who sees that the item is replenished. A man constantly makes the rounds of the forward stock in order to replenish items. Stock limits for forward items are determined very simply; if the item must be replenished oftener than once a day, the minimum is increased; if the item is inactive for six months, it is taken out of forward stock and returned to reserve.

Reserve stocks are accounted for in the usual manner. A running ledger is carried for each item on sheets, such as Form A in Figure 1. Notification of receipt of materials is given the record clerk on Form B, and of issue of materials on Form C. A check record of balances is kept at the bin on the bin tag, Form D.

Replenishment of reserve stocks is controlled either by stock limits or by the plan of quota manufacture described in a previous article (see FACTORY *and* INDUSTRIAL MANAGEMENT, Dec., 1932, page 471).

One or two other details of the storeroom practice of Bauer & Black may be noted briefly. A standard plan of piling is used to avoid the accumulation of old stock. All incoming stock is piled at one side of the bin or space, the piles in stock being shoved to the other side if necessary. Orders are always taken from the old

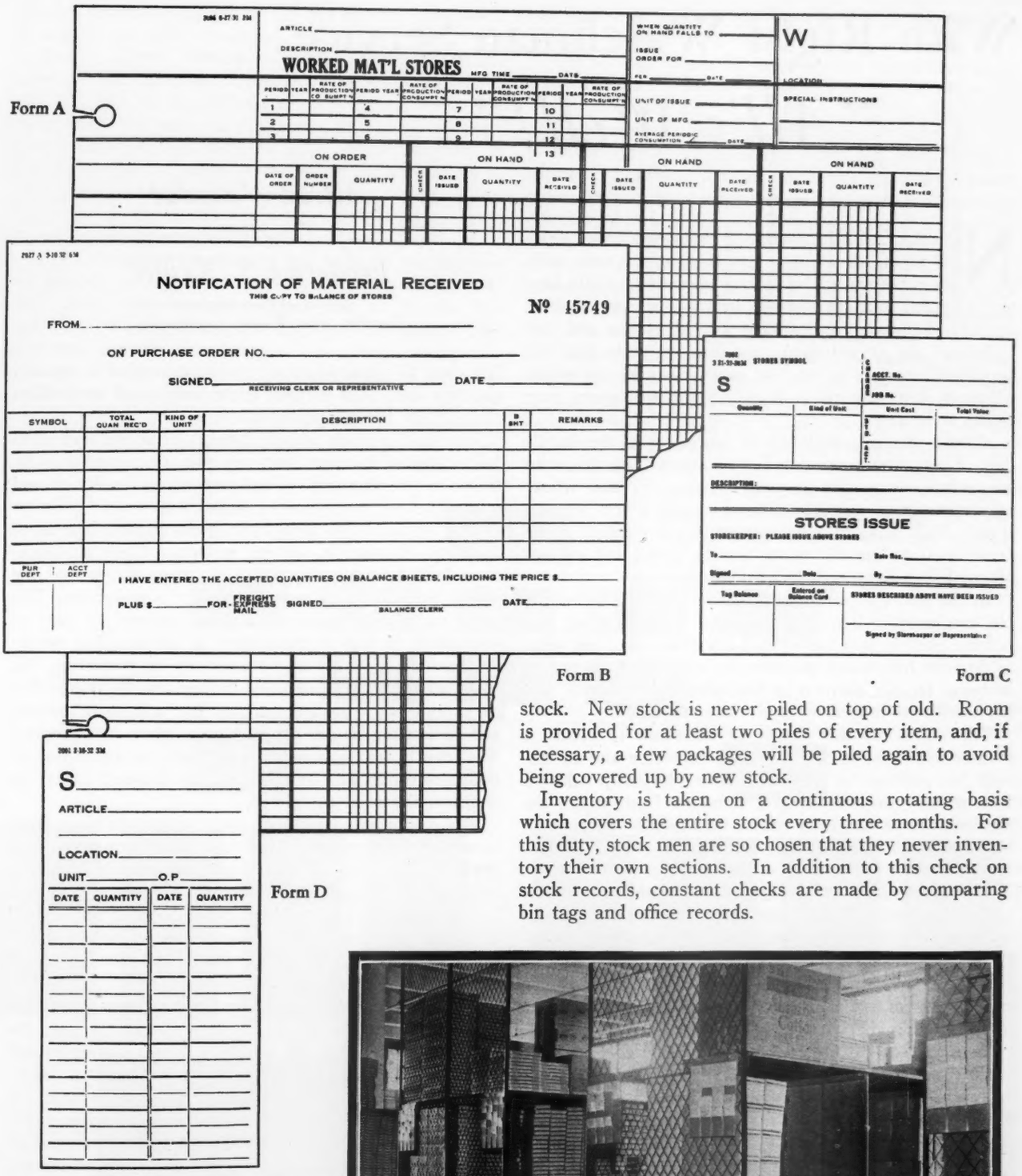
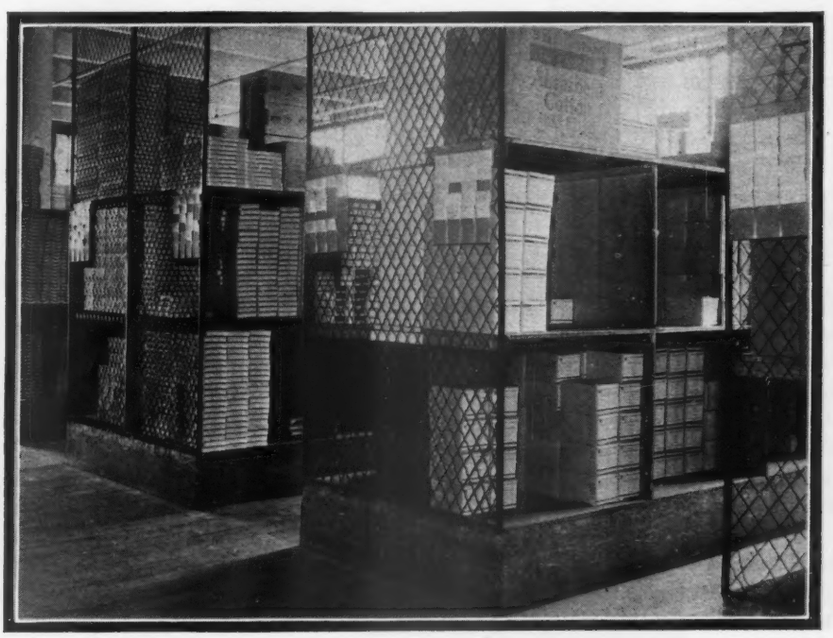


Figure 1. These four forms are used to account for reserve stocks

stock. New stock is never piled on top of old. Room is provided for at least two piles of every item, and, if necessary, a few packages will be piled again to avoid being covered up by new stock.

Inventory is taken on a continuous rotating basis which covers the entire stock every three months. For this duty, stock men are so chosen that they never inventory their own sections. In addition to this check on stock records, constant checks are made by comparing bin tags and office records.



Orders for full cases are ordinarily filled from reserves. Good storeroom procedure avoids accumulation of old stock

With Right Watchman Service

"All's Well!"

Alfred Vaksdal
Plant Engineer

Frederick S. Kriger
Assistant Plant Engineer
Corning Glass Works, Corning, N. Y.

NORMALLY, the continued existence of the psysical assets of a plant rest half of the time with its watchmen. The cost of operating an idle factory is gaged to a great extent by the efficiency of their service. They are representatives of the order and discipline of the organization, and it is on them that the responsibility rests to see that every morning the establishment is a safe place to which the employees may return to work.

Should this responsibility be placed upon the shoulders of men whose sole duty is to punch a clock dial, who are acceptable to the insurance inspector, and whose only incentive is a comfortable chair and a nap between trips? No! Modern watchman service is a trade, whose function is to prevent waste and to detect and correct all conditions dangerous to life and property.

In the past the position as watchman was granted the old employee in lieu of a pension. When a man had become useless, was not wanted anywhere else, and what to do with him was a problem, he was asked to carry a lantern. He was thrown on the industrial junk pile, and his work was judged by equivalent standards.

The object of this article is therefore to create a greater appreciation for the plant protector and to elevate his position to the place where it justly belongs. The writers aim to set up a standard from which the efficiency of performance can be intelligently determined, and to establish an incentive to create a greater interest for those who stay awake while others sleep.

It is a common fault to be satisfied with our own intelligence, but it is blockheaded stupidity to put a man to work without definite instructions. A man will accomplish more, easily and surely, if he has a clear appreciation of his responsibilities and of the duties which he must perform. To establish these for watchmen the accompanying chart has been prepared.

Two classes of protection are considered—day and night. In a plant working normally with modern methods of fire protection and served by safety and fire inspection, the day watching falls mainly to guarding the entrances. The night watchman service must cover the plant itself.

When a watchman is employed in our plant, he is told in a general way what his duties are and what will be expected from him. This is after he has been interviewed and his qualifications, both mental and physical, have been properly considered. He is also given a chart for reference and study, similar to the one shown. He is told that the plant inspector or the head watchman is ready at any time to answer any questions which he may have.

When he makes his first trips, he is accompanied by an experienced watchman who stresses the most important of his duties. When he has learned the major things, the minor duties are called to his attention. After the first few days the plant inspector makes it a point to see and question him. Later these questionings and inspections of his route become periodical.

The records from the watchman's clock are very carefully watched in order that any stations missed may be called to his attention. Furthermore, he is shown and told why these records are checked.

The watchman's duties have been divided into three divisions—protection, service, reports. These classifications hold for both day and night men except that the subdivisions differ. The primary duty is protection. The items considered under service are indirectly a part of protection, if this is considered in its broadest sense; they are dealt with here as accessory to protection, but as of secondary consideration. They are the things that go a long way toward making the watchman service self-supporting by savings in power, labor, and product. The reports are necessary to guarantee the completion of both protection and service, and to prevent, as far as possible, the need for either.

The day or gate watchman must protect the plant from unwanted visitors and keep the plant property from departing by way of the gate. He should carefully examine every pass for person and material.

His house is a place of business and should not be used as a hangout for loafers, discussions of fishing trips, politics, and story telling. He should keep the house and surroundings always clean and neat.

There are, in addition, many small services which the gateman can perform. If the time clocks are near the gate, he can see that the cards are properly rung in and out. If the plant uses an auto-call system, the watchman's house is an excellent location for this service, relieving the telephone operator from considerable work.

Very often the first and sometimes only impression of the entire plant will be given a visitor by the watchman. Courteous and intelligent answers to the stranger's questions are a necessity.

The watchman with eyes will see many infractions of plant rules. While he may have no authority to enforce rules, still he should report any irregularities to his superior who can see that proper action is taken.

The night watchman's responsibility is much greater than that of the gateman. On his first trip through the plant he should take ample time to scrutinize and correct those housekeeping conditions which might constitute a fire menace and which will interfere with the free movement of the fire brigade. He should also make sure that

the fire protective, as well as the fire fighting, equipment is in good operating condition.

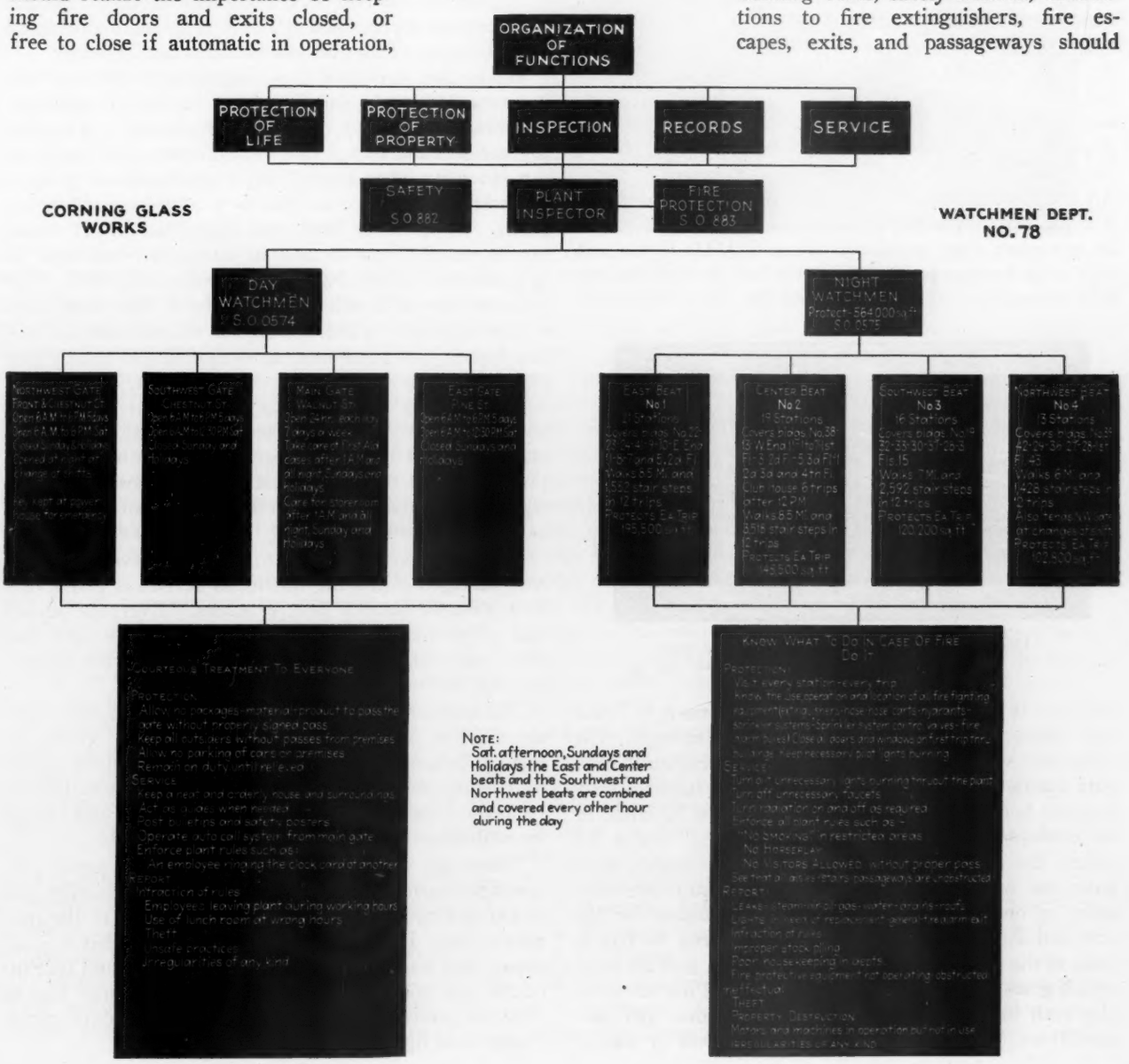
Mr. T. Alfred Fleming of the Conservation Department of the National Board of Fire Underwriters is authority for the statement that "The frequency of fire increases 35 per cent with the time of the closing whistle." Every employee has more or less personal property in the plant, and for some of the workmen it amounts to quite a lot of savings. The company and the employees must rely on the watchman to keep their property from harm for 50 per cent of the day.

It is of primary importance that he know the particular hazards of the plant; where danger may occur; what may cause dangerous conditions, such as oil and gas leaks, heavy voltage lines, and high-pressure steam. The man who has seen long service in the plant has the advantage. He knows from experience what to look for.

Next, he should know the location of all fire fighting equipment and understand its use. Among the important items are the location of extinguishers, small hose, fire alarm boxes, and sprinkler control valves. He should realize the importance of keeping fire doors and exits closed, or free to close if automatic in operation, and should check each one without fail on the first trip through at night. All windows should be closed.

The services incidental to protection which the watchman can give are many. Usually, when a thief is caught the stolen goods can be reclaimed, but when steam, air, oil, gas, or water leaks through a pipe or valve the loss is unreclaimable. Stopping it, though, will prevent future losses. Therefore, let the watchman stop these losses where he can, turn off unnecessary lights and running hot and cold water. He should report leaks of all descriptions, including roofs as well as all idle machines left running. Radiators should be turned off or on as conditions require. The savings in kilowatt-hours, pounds of steam, or gallons of water may easily pay his wages, for such wastes can run into enormous sums.

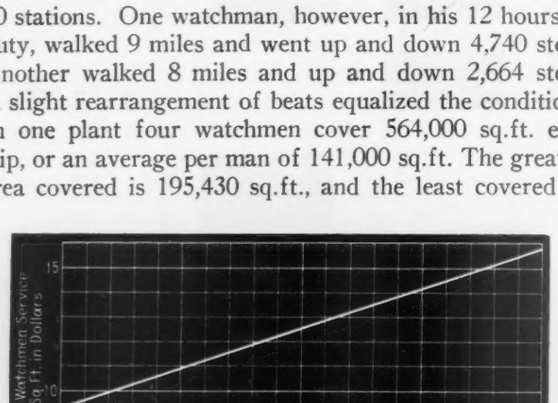
Accidents cause disorganization and delays, physical suffering, and loss of time to the man and of production to the firm. Modern plants spend thousands of dollars each year in making their plants safe. Cooperation on the part of the watchman in this work is not only valuable but necessary. Reports covering icicles hanging from building eaves, safety hazards, obstructions to fire extinguishers, fire escapes, exits, and passageways should



be made. These reports should also cover pilot lights burned out, poor piling of materials, dirty floors, uncleaned railroad tracks, broken windows, dangerous ceilings or roofs, and general bad housekeeping.

It is difficult to measure the efficiency of watchman protection and service as accurately as productive labor, but the relative efficiencies of a group reporting to a single source may be determined rather easily. The occurrence of fires during the night or fires prevented on the different beats may be determined. Check the number of days without fires; also how this affects insurance rates. The number of reports of leaks and other items turned in by different members of the group will give an indication of thoroughness. A verbal or even written examination on location of fire equipment, valves, danger spots, and hazards may be given to a group of watchmen and results tabulated. Changing a watchman to another beat will often show relative efficiency.

Watchmen's beats should be comparable as to importance or area. One or more stations should be changed at frequent intervals with the thought always in mind of how best to protect the most hazardous places. More than the number of stations must be considered. The total distance walked, the area covered, whether open or cut up, and the number of flights of stairs should be weighed in apportioning beats. An analysis of four watchmen's beats showed that all had between 18 and 20 stations. One watchman, however, in his 12 hours on duty, walked 9 miles and went up and down 4,740 steps. Another walked 8 miles and up and down 2,664 steps. A slight rearrangement of beats equalized the conditions. In one plant four watchmen cover 564,000 sq.ft. each trip, or an average per man of 141,000 sq.ft. The greatest area covered is 195,430 sq.ft., and the least covered by


Yearly Cost Watchmen Service per 1000 Sq. Ft. in Dollars
15
10
5
Based on each watchman covering 140,000 sq. ft. of floor area each trip— 12 trips each night, 365 night per year
30
35
40
45
50
Hourly Rate of Watchmen in Cents

Does watchman service cost you more than it should? Here's a chance to check up

one man is 103,000 sq.ft. The first beat has only 1,552 stair steps and covers some large open buildings. The latter beat was shortened to allow this watchman to tend gate during the change of shifts. Four watchmen walk together a total of 28 miles in 12 hours or 12 trips, or an average of 7 miles each. The longest trip is 8.5 miles; the shortest, 6 miles. Using the longest as a basis, the watchman must walk about seven-tenths of a miles in one hour. Allowing him 40 minutes for the trip and 20 minutes' rest between each trip, he has to walk at the rate of only a little more than a mile an hour, which gives him plenty of time to observe his territory, check all items, examine anything suspicious, and note conditions. The above trips were measured by having the watchmen carry a pedometer for several nights and averaging the readings.

Using the beats above as average, a curve has been compiled to show the cost of watchman protection per 1000 sq.ft. per year based on an average coverage of 140,000 sq.ft. each trip for different hourly rates paid for the service. On this basis, 1,000 sq.ft. will cost from $9.38 with a wage of 30 cents an hour to $15.64 per year with a wage of 50 cents. If floor space costs $1.50 per sq.ft. to build, the yearly cost of protection would be, with watchman at 40 cents per hour, a little less than 1 per cent of the value of the property protected. Since the contents of the building are as a rule many times the value of the building, the cost of protection sinks to a very low figure indeed.

This cost for protection is less than the cost of permanent fire protection for the building. The yearly cost of automatic sprinkler protection for carrying charges on the investment would exceed this. If a single sprinkler head protects on the average 75 sq.ft. of floor area and costs $10 to install, the protection per 1,000 sq.ft. per year will cost $13.78 with interest on investment at 6 per cent, depreciation at 3⅓ per cent, and maintenance at 1 per cent. This does not include cost for water.

While the sprinkler head continually protects the property 24 hours a day instead of 12, against fire only, the watchman gives protection intermittently but against a great deal more than fire. A sprinkler head can only put out a fire when started, but a watchman can prevent the start. A failure on the part of either will prove costly. A sprinkler head that might fail to act would not be installed just because its initial cost was less. It is purchased on the basis of protection afforded. The remuneration of watchmen should be on the same basis.

The care with which watchmen are selected and the thoroughness of their training cannot be too greatly emphasized. A study of their present efficiency and of the ways of raising that efficiency has a definite dollar value which should not be overlooked or ignored. As long as state laws and insurance regulations require watchman protection and the plant must carry the cost, it is only right to make this cost become self-supporting, as far as possible, in added service.

In conclusion, it is well to note that even in many well-managed plants the watchman service is given very little thought until a failure occurs. Everyone knows that. Yet we venture to say that there are very few plant engineers who know how many days the factory has run without a fire.

The number of times when preventive measures have saved a loss go for the most part unheard. When the factory breaks the safety records no one thinks of the watchman, and when a foreman accepts compliments from the boss for keeping his shop clean, no one credits the watchman with his part in the good work.

Therefore, when some instance of prompt action preventing a serious damage comes to light, it is only just to express recognition for this achievement to the man responsible. If the watchman only knows what it is all about, that his work is considered a service, and that his efforts are appreciated, it would not only urge him to improve protection but also make the cold dark nights shorter and lighter for him.

Production Control

10. *The Dispatch Station*

Thomas M. Landy

▼

IN THE planning section all the preparatory control functions are worked out, but even the best-laid plans are only dreams unless actually carried to realization. It is just this function which the dispatch station performs. We might say the dispatch station executes what the planning section prepares.

The station about to be described is operated sometimes by one man, never more than two, and usually serves one foreman and from 50 to 100 men, never more. It goes without saying that the dispatcher should be courteous and alert at all times. He should be mechanically minded as well as a good clerk.

The dispatch station consists of an enclosed cage about seven by seven feet. In some exceptionally dirty and noisy shops it may be advisable to use glass-enclosed cages. The cage has one door which can be locked from the inside, and everyone should be cautioned to stay out except the person in charge.

On the front of the cage hangs the floor layout of the department, a copy of the tracing held in the planning section office. The floor layout is referred to constantly by the foremen, move men, and operators, and saves much loss of time. Also framed is the labor indicator (Nov., 1933, page 452) so that all may see the condition of the department.

Operators are serviced through a small window. Directly below the window are attached three small boxes, marked "jobs to be moved," "jobs to be priced," and "jobs moved."

Inside is the dispatcher's desk, especially constructed. There are two large slots for the dead and live files for shop and cost record cards. Along the front is a series of pockets labeled "incoming orders," "queries" (to be kept empty), "vouchers to be posted on shop cards," "vouchers ready for payroll," "cost cards ready for cost department," "central control office," and "piéce rate department."

On the side of the cage is a small box labeled "prints to be returned to central file." In the rear are the dispatch boards.

The dispatch board is built in standard 56-pocket sections, of either steel or wood. Each pocket is divided into three separate pockets, two small and one large. Each pocket represents a machine or group of machines,

After the "make-ready" comes the "do." And the well-organized dispatch station is the "business end" of the production planning and control set-up

or a station of work, such as a bench, oven, etc. Each station of work is numbered, and this number appears on the nameplate over each pocket on the dispatch board. There are two pockets assigned to each work station. One, with red nameplate, contains all the current week's production. The other, with blue nameplate, contains future orders for which material is on the floor or available.

A simple code facilitates the operation of the dispatch board. The upper pocket is the container of the order in process. The second pocket is the container of the next order to be run. The lower, or large, division contains the orders waiting to be run. White card in the upper pocket indicates *no work*. White card in the second pocket means *no work ready*. Pink card in the upper pocket indicates *no operator*. An order with red card attached means *rush*. Green card in upper pocket indicates *millwright*. Blue card in upper pocket indicates *reference* (job running on more than one machine).

After an order has been indexed it is placed on the dispatch board in its proper place, governed by the following rules:

1. Defective work.
2. Assembly floor hold-ups.
3. Shortage (in promise-date order).
4. Due dates.

A good dispatcher never gives out more than one job to a workman. (Exceptions will be made by the dispatcher in charge when deemed advisable.) He never

Amt. 42 S. O. 245818

MOVE

Dr. No. 2576269 Pt. No. 1 Name Yokes

FROM

Mach. 403 Bldg. 16 Bay 7

TO

Mach. 420 Bldg. 16 Bay 9

SW-3983-A 25m 7-30-30

Figure 1. Special form used by dispatch station operator when no move card is available

42 12 15 12 17 12 30 245818

JAMES MURPHY # 22602

NO COMP

APPROVED

ST 20- MO #10- ST 26

2576269 PT 1 YOKES, C.I. 2576211 PATT-C

1	BO.FC.TU.ANGS.	403 MO	195.	3.5E
2	FACE	403 MO	45.	1.40E
3	DR.FOR STUD & HDLE	420 MO	15.	1.56E
4	BRO. 4 HOLES	426 MO	15.	1.10E
5	MARK 3 LINES	438 MO		72.C
6	SNAG BEFORE P&J OP	428 MO		45.C
7	C-SINK FOR RV.	420 MO	10.	22.5C
8	STAMP 2 ARROWS	438 MO		40.3C
	APPROVED	438 MO		56.C

ORIGINAL

Figure 2. When the work is complete, the workman stamps name and number on his voucher

issues a new job until print and vouchers of the old job have been returned.

If there are several orders on a particular drawing number, he sees that one workman runs them all on the same set-up, and crosses out with red pencil all set-ups but one.

After the vouchers have been given to a workman, the dispatcher places the dispatch order and the balance of the vouchers back in the upper pocket of the dispatch board, which shows the order is in process. At the same time he withdraws the dispatch order and set of vouchers of the old job, circles the number of the next operation and place of work, attaches print, and places it in its respective pocket in the order prescribed above.

On the move card (Sept., 1933, page 363) he circles the old and new places of work and passes it over the sub-index posted on shop card and then into the box provided, marked "jobs to be moved." When the job has been moved and the card returned to the box marked "jobs moved," the dispatcher immediately replaces the move card on the dispatch order.

If no move card is available, he uses the special form shown in Figure 1, and follows the same routine. He must be quick and accurate, but always accurate. He must always see that there is an order in the next job pocket, and consults the foreman if necessary.

If there is attached to the dispatch order an identification tag, it will indicate that the raw stock is still in the storeroom. Hence, when the dispatch order has worked itself up to position in the next job pocket, the move card and identification tag are removed and sent to the storekeeper as a signal to move the material to the machine which is going to do the first operation. Of course judgment must be used as to the time allowed to do the moving. No definite time allowance can be set.

When the move card is returned to the box marked "jobs moved," it is at once placed back on the dispatch board attached to its respective order. When the cycle of operations is complete, the dispatch copy is stamped complete and sent to the central control office. The dispatcher also sees that vouchers are sent to the payroll department.

The sub-index is now removed and sent to the cost department, where it serves as the cost record.

The box on the cage marked "jobs to be priced" is used by the workman when a job is given to him marked "time study." Likewise, if he has any grievance over a price, he drops his voucher in this box and goes ahead with his work. It is the dispatcher's duty to ask the planning office to send a time-study man.

Since the dispatch station is the all-important cog in production control, it is essential that it notify the central production control office of any suggested changes in routine or any contemplated changes in planning.

Vouchers should be sent quickly to the payroll department to eliminate peak loads in that department. Cost cards should be promptly sent to the cost department, and completed dispatch orders, as well as drawings should be promptly returned to the central office.

To handle night shifts the dispatch operator obtains from the foremen the stations to be operated and the approximate amount of unfinished work that will remain when the day crew leaves. He lays out the necessary work tickets to keep the night crew working and instructs the stockkeeper to get ready for delivery to the stations involved the necessary material required.

All parts to be worked on which have not yet been delivered to the stockroom, but will be ready for the night crew, are noted, so that the night foremen will know where these parts are coming from. The day foremen return to the dispatch board operator all tickets for work which has not been started by the night crew, and the dispatch board operator will place these orders back on the board in the proper sequence.

In shops functioning with a full night shift, it is advisable to have a full-time dispatcher on duty.

At the end of any period when the workman must turn in his time voucher before he has completed the full quantity shown on the voucher, the dispatcher fills out a balance voucher. This should be done when there is a day and night shift on any work station as well as at the end of the payroll period.

At each dispatch station are located a small hand addressograph, as well as the workman's pay number and nameplates. When necessary, the operator makes proper use of this plate to stamp his name and pay number on his voucher (see Figure 2). He should not stamp it until work is complete, as it is possible that he might have to return the voucher unused.

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Mr. Landy's next article, scheduled for March, shows how inspection is tied in with production planning and control

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The Maintenance Engineer's Responsibilities

C. F. Scribner
Industrial Engineer
Asheville, N. C.

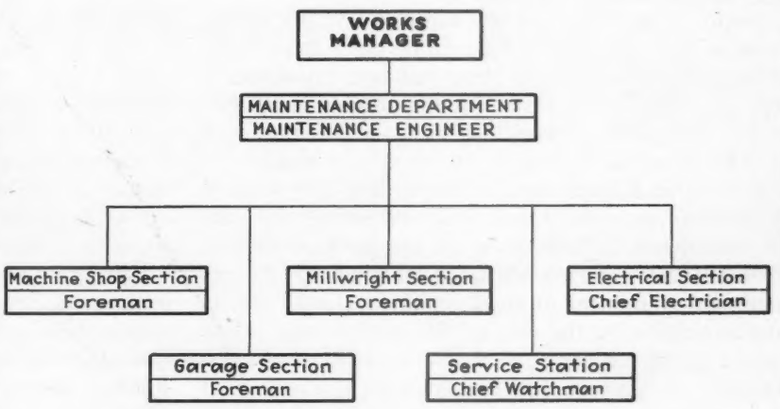
THE MAINTENANCE department is organized and operated for the purpose of maintaining established standards as to equipment, service facilities, and operating conditions throughout the plant. Upon the maintenance of these conditions depends adequate performance of production operations, both as to the methods to be followed and the time consumed by such operations.

Under modern methods the primary function of this department is preventive rather than corrective. This viewpoint must be kept in mind in allocating the responsibilities of the department and setting up the qualifications for the engineer who is to head it. Maintenance work under older methods consisted principally in repairing equipment after it had reached a stage at which it could no longer be operated.

Older methods placed the responsibility for the condition of equipment upon the superintendent, who passed it on to the foreman of the department concerned. The repair department took no initiative in the making of repairs or in keeping equipment in first-class operating condition. Its services were called into play only when it received an order from the superintendent or foreman.

Such conditions often led to machines being run after they were in bad condition, resulting in lowered output and low quality of work. Often repairs were delayed until a breakdown occurred, bringing with it serious injury to workers. In nearly all cases such breakdowns prevented further operation of the equipment until extensive repairs were made.

With modern management methods the maintenance department is required to operate in such a manner that it anticipates and prevents as far as possible any loss of output occasioned by the interruption of manufacturing schedules through machinery or equipment failures or breakdowns. Here the department assumes the initiative, and the responsibility, instead of being scattered among



The maintenance engineer is responsible to the works manager for:

1. Direction, supervision, and coordination of all sections of the maintenance department, as indicated on the foregoing organization chart.

2. Furnishing light, heat, power, compressed air, hot and cold water, steam, ventilation, sewage, and fire protection.

3. All elevator and janitor service.

4. All millwright work, rigging, moving, and erecting of machinery and equipment in the various departments.

5. Maintenance of all belting in the condition necessary to transmit the required power most economically. Oiling and maintenance of all power transmission machinery.

6. The installation, alteration, and repair of all electrical equipment throughout the plant, with the exception of the telephone equipment belonging to the Bell Telephone Company.

7. The inspection at stated intervals of all motors, generators, boilers, transmission machinery, machine tools, and other machinery in the plant; also the inspection of all factory and building equipment in the plant, except special tools and attachments for machine tools. The issuing of proper orders for repairs before a breakdown actually occurs.

8. Repairing all machine tools and special machinery in the plant.

9. All sweeping and cleaning within and without the plant.

10. Watchman service necessary for the protection of all company property and all records relating to this service.

11. Supervision of all company garages and employees connected with the garages; supplying automobiles, trucks, and drivers in accordance with authorized requests; the proper care, service, upkeep, and repair of all automobiles and trucks; rendering correct reports of all receipts and disbursements of materials and supplies in the garage; and the proper accounting for the time of all employees on the garage payroll.

12. Putting into operation plant orders for all work to be performed by all sections of the maintenance department and following up such orders to early completion.

(Signed) GEORGE M. HASKELL
Works Manager

the foremen throughout the plant, is centralized in one department head. It becomes a matter of primary importance, therefore, for the maintenance engineer and the men in his department to devote their entire time and energy to the job of performing this work in a consistent and systematic manner.

To appreciate fully the importance of maintenance work under modern manufacturing conditions requires an understanding of the methods applied to productive work. In production each operation is analyzed and studied, unnecessary motions are eliminated, defects in materials are corrected, and improvements are made constantly in machines and equipment.

Operating conditions are standardized and, by means of time studies, the time that should be taken to perform each part of the work under these standard conditions is determined. This study results in establishing an allowed time for each piece of work. It is against this allowed time that the workers earn, or fail to earn, a bonus.

Because this allowed time is based upon the premise that machines, equipment, and tools will be kept in first-class condition it is impossible for the workers to earn their bonus unless this condition is maintained. Failure to maintain equipment in good condition always results in dissatisfaction on the part of the workers and a loss of profit to the company.

Despite all precautions, breakdowns will occur at times. When they do occur, they are dealt with according to the best judgment of the maintenance engineer, who gives due consideration to the urgency and nature of the repairs to be made and to the importance of taking necessary steps to prevent a recurrence of the trouble.

Inspection of all machines and equipment is made at regular periods by inspectors from the maintenance department. This work is planned in advance and followed up. Detailed and specific instructions are supplied, which give information in regard to the machines to be inspected with the necessary adjustments and minor repairs to be made at the time of inspection.

To carry out this plan of inspection systematically, certain inspection records and reports are necessary. The intervals at which each inspection is to be made are fixed according to the judgment of the maintenance engineer, subject to later modification as experience indicates the necessity or desirability of a change. These intervals should be short enough to insure the detection and correction of wear and misadjustment before these items reach a point where they interfere with the quality or quantity of work produced.

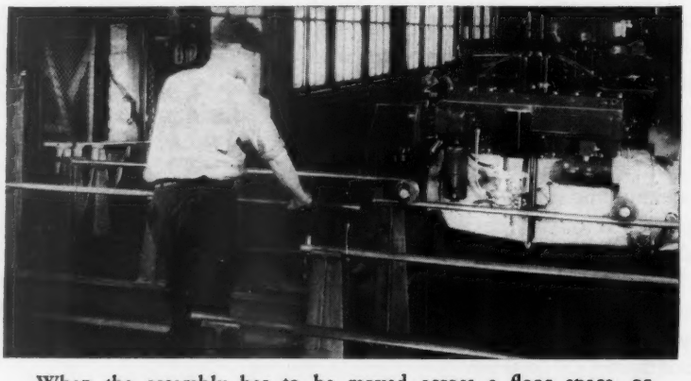
To a considerable degree, the responsibilities assigned to the maintenance department will determine the qualifications of the maintenance engineer. The type and size of his organization will determine to whom he is responsible in a given plant.

One plant, employing about 500 men, makes its maintenance engineer responsible to the works manager. His responsibilities are made clear to him and to all others concerned by means of the chart and outline of responsibilities shown in the accompanying diagram, a copy of which is furnished to every department head in the plant. In this organization satisfactory and effective operation was secured, but it was necessary to try out two unsuitable men before the maintenance engineer was found who could fill the job satisfactorily.

▼ ▼ ▼

Riding the Rails

AN INTERESTING application of a basic handling principle is seen in the assembly of motors at Packard Motor Car Company, Detroit. It is always economical when practical to keep a piece of work moving along by the same general conveyance, thus avoiding needless shifts from one form of transport to another. At the Packard plant, when the crank case has been machined and starts through assembly, four flanged casters are bolted into four holes in the block which will later be used for fastening the engine to the frame.



When the assembly has to be moved across a floor space, or where it is necessary to change the direction of the flow of work, it's done with a dolly

Once the casters are attached, the crank case which is the base for the motor assembly moves along pipe rails about 30 inches above the floor. It is pushed from operation to operation. Where it must be moved across a floor space, this is accomplished by means of a dolly which runs on floor rails. The upper part of the dolly consists of pipe rails exactly matching the rails of the motor assembly line. The motor is therefore pushed onto the dolly, and the dolly is then moved along the floor rails to the next set of rails at working height. Where it is necessary to change the direction of movement of the work, this is done by sliding the engine upon a dolly at the end of a line, pushing the dolly around a 90-deg. curve, and then back onto another set of rails. Similarly, where several lines of benches are working on the engines, with another set across an aisle, it is only necessary to have a floor track and one dolly to serve as a bridge for the lot.

The work stays on the pipe rails all the way from the assembly operation into a dumb waiter which delivers it downstairs to the final car assembly line, after putting it through running-in and the many testing and inspection processes. Part of the time its rails are on a dolly, but its basic method of transportation never changes.

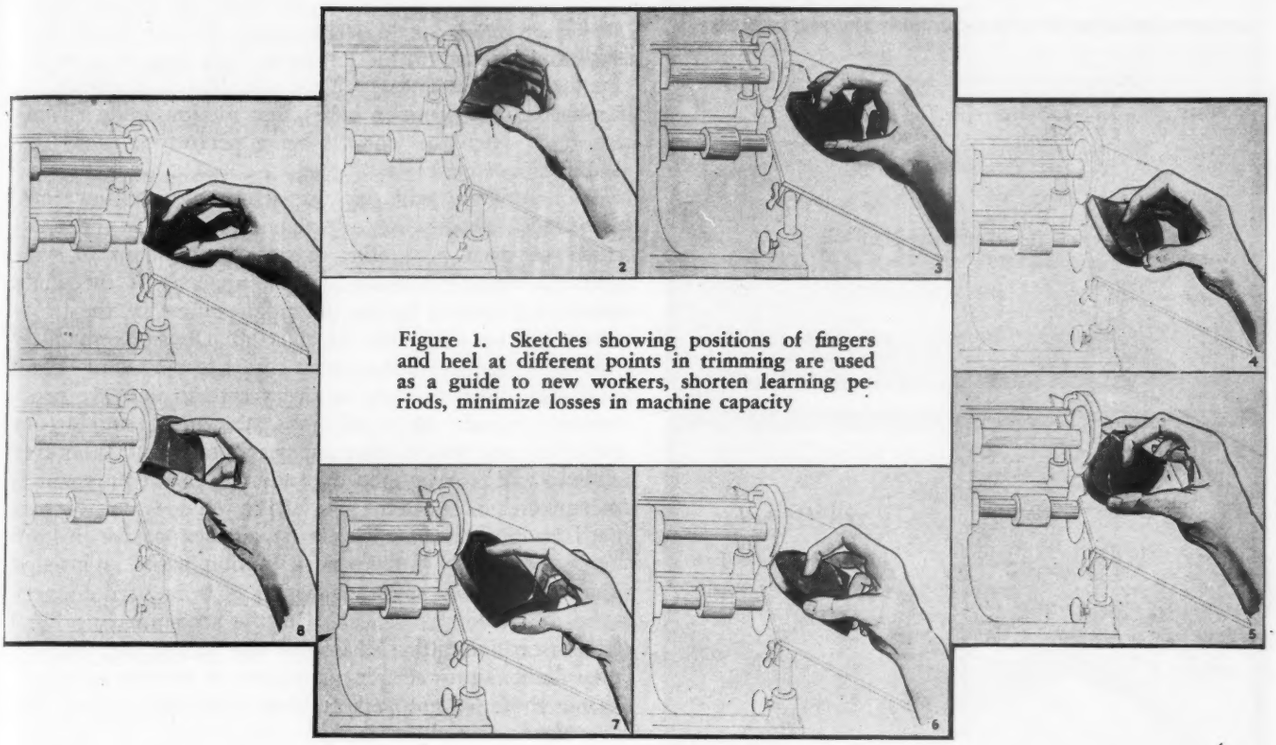


Figure 1. Sketches showing positions of fingers and heel at different points in trimming are used as a guide to new workers, shorten learning periods, minimize losses in machine capacity

Motion Study Shows New Help, Old Help, How

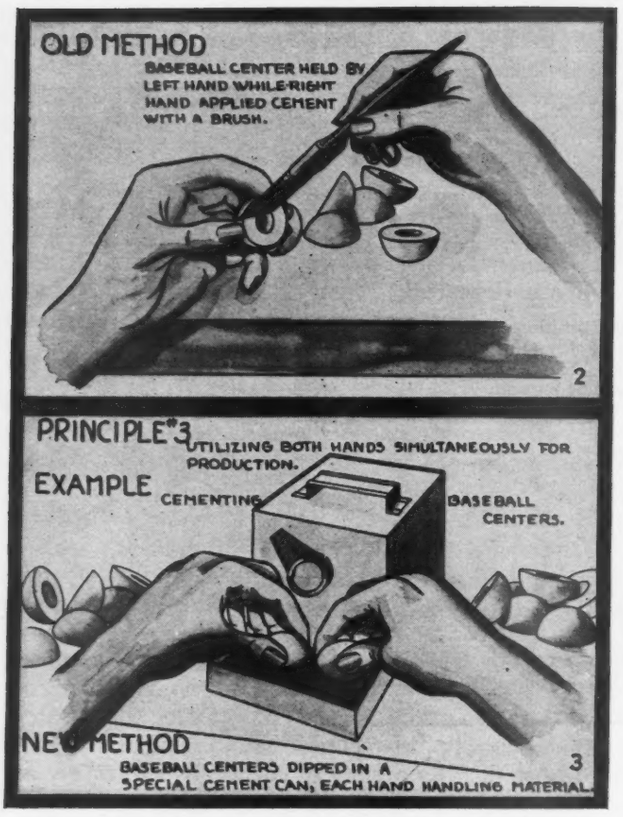
H. Resseger

Manager, Time Study and Standards
Mechanical Division, The B. F. Goodrich Co., Akron, Ohio

IT HAS often been taken for granted that a division like ours, manufacturing as it does some 32,000 items, is totally unsuited to the profitable application of motion studies. The activity of this division is characterized not only by a diversity of products but also by small job lots on certain seasonal lines which might render any detailed study or analysis uneconomical. Motion study has nevertheless been applied to very good advantage both in the reduction of direct labor costs and in the training of new employees. This result has been attained by making all of the time-study engineers and factory supervisors motion-minded through a series of classes in which the principles of motion economy were taught and demonstrated on operations in their own departments.

Since motion study, in addition to being a means of improving manufacturing processes, can also be used in training new personnel, it was decided to apply it to a finger operation which consistently showed a high labor loss whenever a fluctuation in production made it necessary to hire additional workers. This operation, known as trimming, consists of removing the rind from the edge of a vulcanized rubber heel by the use of two power-driven rotary knives. The skill and finger dexterity required of the operator is above the average, and because the moves are faster than the eye can follow, a long period of time was usually spent by the new worker in trying to master these moves sufficiently well to earn even the guaranteed learner's rate. This resulted, first, in a large labor loss developed by the beginners; second, in a loss in machine capacity, because it became necessary to add other shifts with extra supervision.

In making the preliminary survey, the first discovery was that even the oldest and most efficient trimmers did not know the finger moves they made in spinning the heel between the knives. They had developed these moves automatically after long months of practice. All beginners would do the same if given enough time. To


OLD METHOD
BASEBALL CENTER HELD BY LEFT HAND WHILE RIGHT HAND APPLIED CEMENT WITH A BRUSH.
2
PRINCIPLE #3
UTILIZING BOTH HANDS SIMULTANEOUSLY FOR PRODUCTION.
EXAMPLE
CEMENTING
BASEBALL CENTERS.
NEW METHOD
BASEBALL CENTERS DIPPED IN A SPECIAL CEMENT CAN, EACH HAND HANDLING MATERIAL
3

Figures 2 and 3. Penalized for holding. In the old method the left hand held the part 90 per cent of the time. New method allows use of both hands for cementing, reduces time 60 per cent

shorten this learning period, a detailed motion study and analysis of the movements of the hands and fingers was instituted.

It was found advisable to sketch the position of the fingers while spinning the heel. Eight sketches were therefore drawn showing the various positions of the fingers and the heel in relation to the knives at different points during the trimming process. The direction of the heel movement and of the finger used as the propelling force was clearly indicated by arrows. These sketches (see Figure 1) were photostated on one large sheet. Each learner placed her sheet beside her as a guide.

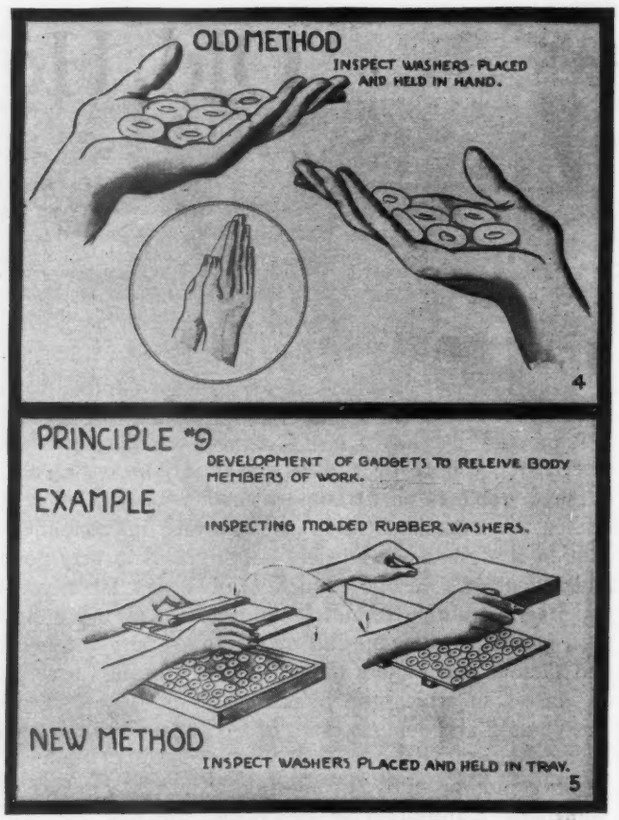
A careful explanation of the pictures and study was given to the new workers before they started on the job. The importance of following the moves as outlined by the study was emphasized, and it was proved that it is practically impossible to get a free, smooth trim by any other method. The number of heels trimmed per hour was not stressed. The plan of instruction was: (1) teach the correct moves; (2) get quality workmanship; (3) attain necessary speed.

This type of instruction is based upon the assumption that, by using the correct moves, quality and speed will naturally follow in their proper sequence. The results of this plan have been very satisfactory both to the management and to the new workers. It is true that losses on this operation have not been entirely eliminated, but they have been materially reduced by a much shorter training period than was possible before.

The application of motion analysis is not confined to mass production. The net return in actual dollars saved, from each study made or improved method installed, is naturally greater on the large-run item than it is on the small-volume business. This has had a tendency to strengthen the common belief that motion study is only advisable when the work is being performed every day and in large quantities.

Motion study will pay for itself on small-lot jobs, provided a good sense of balance is used by the time-study engineer. In other words, the amount of time spent in making a study and the analysis of the study must be governed by the potential volume of the product. In the Goodrich Mechanical Division, small-lot jobs have been studied without resort to a mass of detail. Although effort is made in every case to improve processing methods on small jobs, the most satisfactory method is not always the most nearly perfect. Wherever volume will warrant the expenditure, new equipment is recommended, but if the size of the job does not warrant the buying of new equipment, small inexpensive jigs are made, or merely a change in motion paths is insisted upon. Small inexpensive jigs have been used to very good advantage as indicated by the accompanying illustrations. These few examples are picked out because they demonstrate certain principles of motion economy. While they are not perfect, they represent distinct improvement over old methods.

The old method of cementing half-balls for baseball centers (Figure 2) consisted of picking up the half-ball and holding it in the left hand while the rubber cement was being applied with a small brush held in the right. After the cement had been applied evenly around the



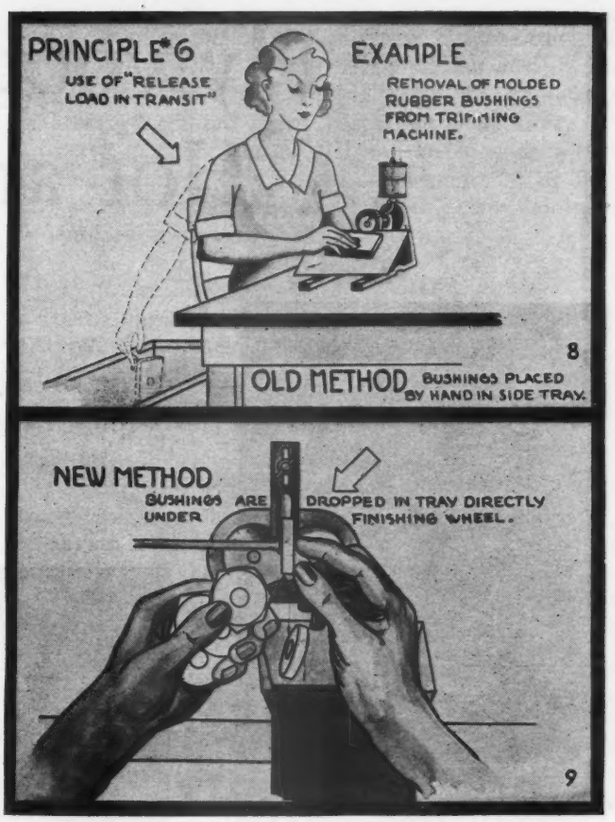
Figures 4 and 5. Board replaces hand as holding device. Both hands now free to pick out rejects. Result, quicker and better inspection at 40 per cent of the old cost

edges, which required fifteen or twenty shoulder moves with the brush, the piece was placed aside on a drying rack until ready for the next operation. The left hand in this operation was used as a holding device during the actual cementing, or around 90 per cent of the over-all time.

Figure 3 shows the revised method. A small cementing device, working on the principle of a chicken feeder, allows the use of both hands for cementing. The revised operation consists of picking up a half-ball in each hand, cementing and placing aside on the drying rack. The cement is spread evenly by using a twisting motion with the wrist while the half-ball is on the cementing screen. By eliminating shoulder movements formerly used in stroking with the brush and using both hands for handling, our time per ball for this process has been reduced approximately 60 per cent.

Figure 4 is the old method of inspecting small rubber washers, gaskets, toy tires, etc. These pieces were handled in small numbers and were held in the left hand while the right was used to discard any defectives which might appear. When one side had been inspected, the hands were placed palms together and the pieces turned over and held in the right hand while inspecting the other side.

In the revised method (Figure 5) small inspecting boards, 12 inches square and holding approximately 100 pieces, are used to hold the parts while the eyes are looking for defectives. After looking at the one side, the top is placed on the board and both are turned over, the pieces now being on the top board and in position for inspecting the other side. Operators have been trained to inspect the pieces by looking from the rear to the front of the board. In this way it is possible to see the total surface by looking down the board twice, or in practically the same time formerly spent in looking at the pieces held in the hand. The resultant decrease in inspection cost has been approximately 60 per cent. Eye strain has been lessened by painting the boards a dark green, for use when inspecting pieces made of white rubber. Natural boards are used when inspecting articles of darker hue.


PRINCIPLE *6
EXAMPLE
USE OF "RELEASE LOAD IN TRANSIT"
REMOVAL OF MOLDED RUBBER BUSHINGS FROM TRIMMING MACHINE.
8
OLD METHOD BUSHINGS PLACED BY HAND IN SIDE TRAY.
NEW METHOD
BUSHINGS ARE DROPPED IN TRAY DIRECTLY UNDER FINISHING WHEEL.
9

Figures 8 and 9. Parts and costs are properly trimmed. Credit drop delivery with an assist. The right hand is always doing, never transporting. The left makes ready the next piece

Figures 6 and 7. Splicing gaskets in mid-air is a good trick if you can do it. The simple jig guarantees perfect butt splices in one-tenth of the time formerly required

Figures 6 and 7 show the old and new methods of splicing washing machine gaskets. As these gaskets have a very thin wall and have the ends cut on a bias, the joining of the ends in a perfect splice was very difficult and slow. A small inexpensive jig was made for this job, which eliminated practically all the slow moves formerly made and reduced the work to merely laying the ends over the jig and sliding together. If the ends are held down, it is impossible to get anything but an even butt splice. The new method requires around 10 per cent of the time formerly spent for this work.

A good example of drop delivery is illustrated in Figures 8 and 9, where small rubber parts are trimmed by two power-driven rotary knives. A small chute built directly in front of the knives allows the operator to release the piece immediately after it is trimmed. This eliminates the transferring of the piece with the right hand from the machine to a tote box. The left hand is used in making ready the next piece to be trimmed by placing it in position on the machine.

Plywood Gluing Hot and Dry

New hot-press adhesive process makes intelligent use of the impounded moisture in wood, uses dry glues, avoids time-consuming re-drying, cuts pressing time to a matter of minutes, produces better plywood

Four-spindle veneer splicer unites edges without using tape, operates on chain-feed principle with heated rolls to set adhesive

Thomas D. Perry

Chief Engineer
United Plywood Corporation
New Albany, Ind.

When sheet glue is used as an adhesive, the dry glue film is cut to exact dimensions preparatory to hot pressing

Assembling core, sheet glue, and veneer—the quick, clean method made possible by advances in plywood art

THE ECONOMICAL and satisfactory gluing of wood has been and is a fundamental requirement in all branches of the woodworking industry. Some twenty years ago starch (casava), casein, and albumin (blood residue) glues obtained definite and substantial recognition as wood adhesives of low-cost or of unusual water-resistant qualities when compared with animal glue. Later other adhesives, such as silicia (liquid glass) and soya bean flour found limited low-cost uses. The preparation and use of these adhesives followed the conventional and traditional processes of age-old animal glue. They were dissolved, converted, or mixed with a solvent (usually water), with or without heating, until they closely resembled animal glue, and could be spread as a syrupy fluid on the wood parts to be joined. The maximum adhesive strength was developed by evaporating the solvent, a time-consuming factor.

The American plywood manufacturer had been meticulous in the preparation and storing of his face veneers, cross-bands, and lumber or veneer cores at a normal moisture content of about 5 per cent. At the moment of spreading the fluid glue (of any of the above principal types) on the veneer and of squeezing the assembled plywood in the press, the solvent of the glue increased the moisture of the veneers to 15 to 25 per cent, with inevitable expansion and distortion of the wood fibers. As long as the plywood was kept under pressure, it remained flat, but as soon as the pressure was released, the internal stress and strain of the adjacent and usually rectangularly grain-opposed layers manifested itself in warping, twisting, and other forms of distortion, varying in degree during the process of evaporating the moisture introduced by the fluid glue.

Experienced plywood makers struggled zealously to eliminate the results of this internal stress and strain by promptly and intelligently drying out this glue moisture, after releasing the pressure, in practically designed redriers. When plywood was clamped flat with adequate

surface exposure during this re-drying process, it was possible to restore the prior normal moisture content of 5 per cent, but the re-drying process consumed several days, involved many handlings, increased manufacturing costs, and left a possible hazard that some pieces might have been inadequately re-dried, or might later absorb moisture after fabrication.

Progress Changes Processes

It was a recognized fact that albumin glue had a two-stage setting process, first by ordinary evaporation, second by coagulation under suitable heat and pressure; that latex would solidify or vulcanize under sufficient heat and pressure; and that phenolic resins would harden or polymerize under adequate heat and pressure. But there had been scant adoption of these facts by the woodworking industry. These three adhesives, possessing unusual water-resistant characteristics, were available to woodworkers, but they did not conform to the traditional wood-working standards.

Residual Moisture in Wood

Wood is hygroscopic, which is to say it will retain an appreciable amount of impounded moisture that cannot be eliminated practically. Under normal conditions this residual moisture content will average 6 per cent, and unless mechanically controlled may be 10 to 14 per cent for kiln-dried lumber and veneer.

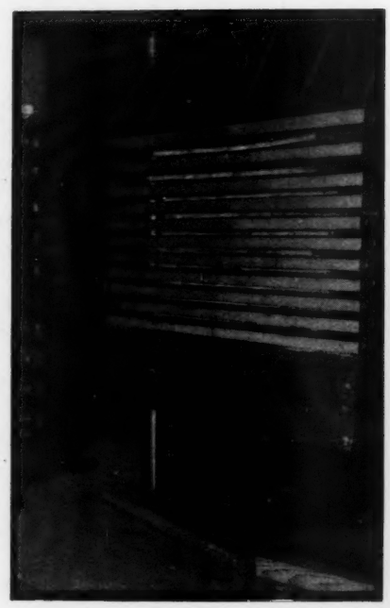
Recent research has demonstrated that this residual moisture has a value in the adhesive processes. The fundamental principle is that of pressing two or more layers of wood (containing residual moisture) at known temperatures in a steam or electrically heated hydraulic press with strata of dry (nominal atmospheric moisture content) glue between the wood layers. The heat vaporizes and releases the impounded moisture, and the pressure forces the released moisture into the glue, resulting in an adhesion that is superior to that made by the normal evaporation of fluid glue. The glue strata may be sheet glue (thin paper coated on both sides), or powdered glue, mechanically spread and bonded with a minimum amount of moisture, or a thin film of fluid glue on each wood layer, pre-dried to normal moisture content before pressing.

Dry Glue and Hot Presses

The intelligent use of this residual moisture factor in hot presses has opened two paths to new gluing procedures. The alternatives are the hot-press completion of evaporation processes on animal, casein, soya bean, and other like adhesives, or the utilization of the solidifying processes employing latex and phenolic resin.

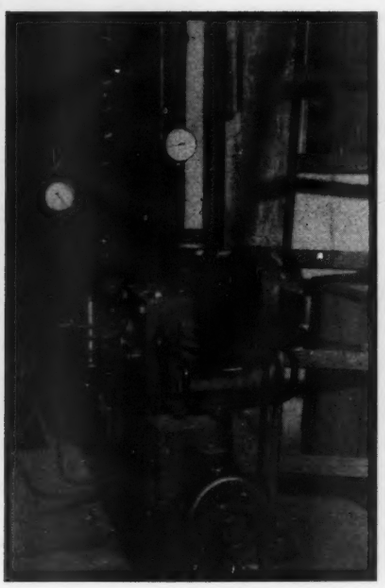
If sheet glue is used, it need only be assembled between the veneer sheets before hot pressing. If fluid glue is pre-spread and pre-dried on the crossings, or if powdered glue is sprayed on the veneer, the coated veneer can be similarly assembled for hot pressing. The time consumed in pressing is measured in minutes, rarely exceeding half an hour, and the plywood taken from the press is thoroughly glued and completely dried, needing only trimming to size and a minimum of sanding. In fact, the hot pressing, instead of "raising the grain," as fluid glues in cold presses are prone to do, irons down and smoothes out the face veneer fibers, giving a sheen or luster that may even eliminate the minute scratches and "whiskering" of sanding, and that will inevitably facilitate the finishing operations.

The technique of hot-press gluing has only been commenced; much remains to be done to achieve the mastery of this new phase of plywood making. The new hot processes are only slightly more than a year old in the United States, but they bid fair to improve the steps in plywood fabrication and to establish new standards of plywood quality, in durability, sturdiness, appearance, and utility.

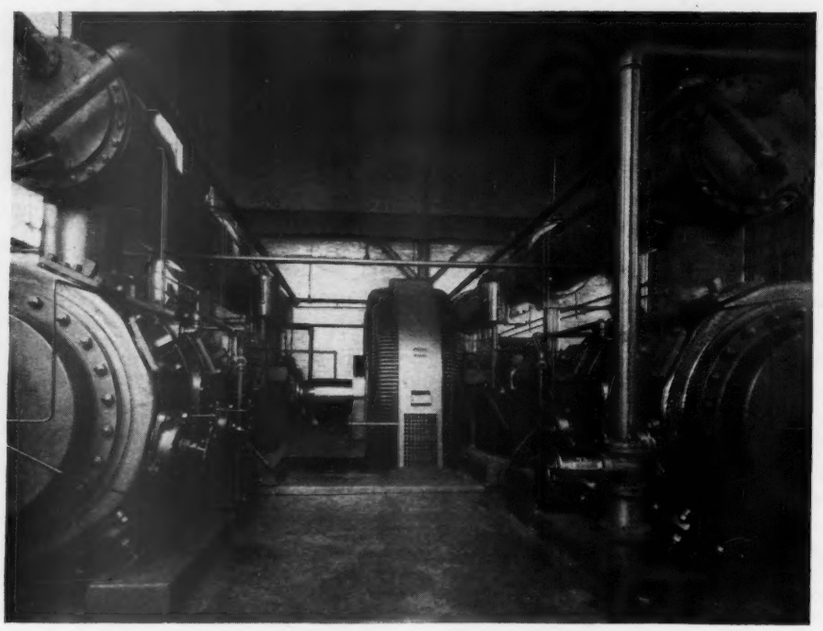


Here the assembled plywood is shown placed in the openings of the hydraulic hot-plate press just prior to full closing

Control unit on hydraulic hot-plate press automatically regulates temperature, specific pressure, and time of pressure



And now the completed panels are removed from the hot-plate press, the pressing time consumed being measured in minutes



Starting a 3,000-hp. motor can cause more than a ripple on the power lines of even a large plant. This motor, which drives a gas compressor, is arranged for part-winding starting. By this method the equivalent of reduced-voltage starting is obtained, without the large autotransformer that otherwise would be required

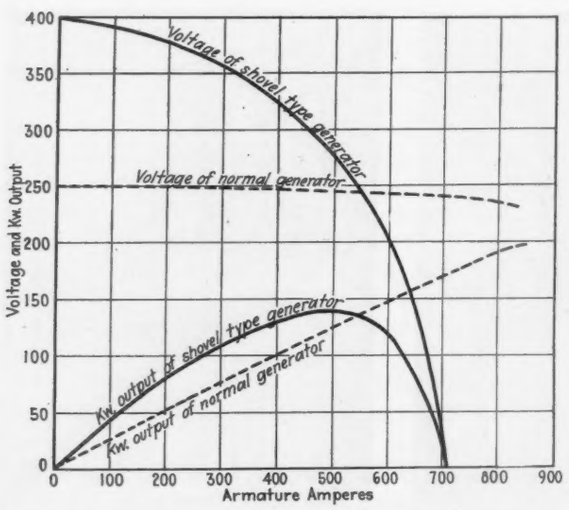
Low Peaks, Low Power Bills

R. H. Rogers

Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

VIOLENT fluctuations in the amount of power used by an industrial plant are likely to be expensive. If power is purchased, unusual demands lasting from 5 to 30 minutes may increase substantially the power bills for a whole year. Demand rules the rate structure and should be held under strict control, to make economical use of the money spent for power.

If a plant generates its own power, operating conditions will be adversely affected because of the relatively small capacity of the generating station. Bad voltage conditions and frequent outages result from untamed power consumption. Again, either with purchased or generated power, maintenance costs will be increased by high peaks and excessive demands because they indicate overloads, continued overstrains, and too-frequent operation of current-opening devices.



A differential series field winding on the "shovel-type" generator automatically limits the peak loads. These curves are for a generator rated 100 kw., 250 volts

Erratic load behavior can be forestalled by the judicious selection of equipment and by skillful management of plant operations.

Irregularities in the load curve may result from:

1. Loads comprising a succession of peaks, such as those produced by power shovels, hoists, resistance welders, rolling mills, and so on.
2. Loads of sufficient magnitude and characteristics to make starting and accelerating difficult, however infrequent.
3. Motors of a size that draw excessive current when starting and accelerating, because of their nature or kind of control used.
4. Motors too large for present duty but required for future loads.

Selection of equipment for the first class of cases may include the use of flywheels if the peak demands are of

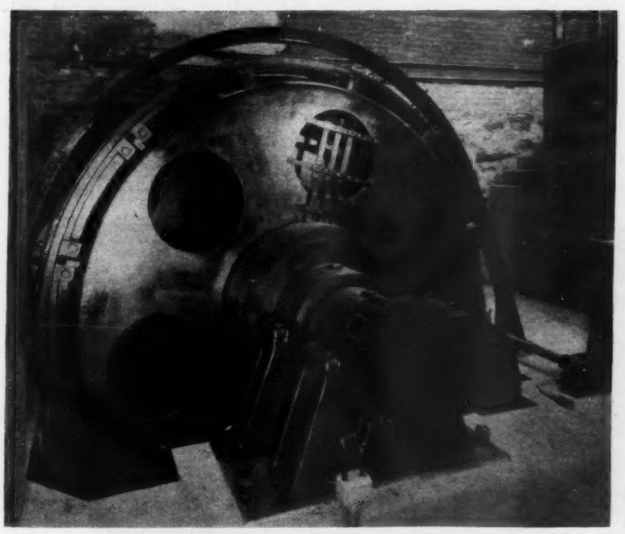
short duration, say a few seconds. Direct-current motors that are started and stopped, reversed, or have their speeds changed much with each cycle may be driven by a motor-generator set having a flywheel. Mine hoists and rolling mills use these flywheel sets to "iron out" the demand peaks. In this way peaks of 1,700 kw. or so occurring every 100 seconds can be changed to a fairly constant demand of 300 kw. from the power line.

To take advantage of a flywheel, means must be provided for allowing the speed to rise on low loads and to fall when high demands come on. One such means is the slip regulator, which automatically inserts and removes resistance from the secondary circuit of the wound-rotor induction motor that drives the set.

Smaller a.c. motors used with flywheels are designed to have much more slip than standard and are called "soft" motors since they yield readily to load fluctuations, thus transferring much of the load to the flywheel. Punch-presses and similar drives are in this class.

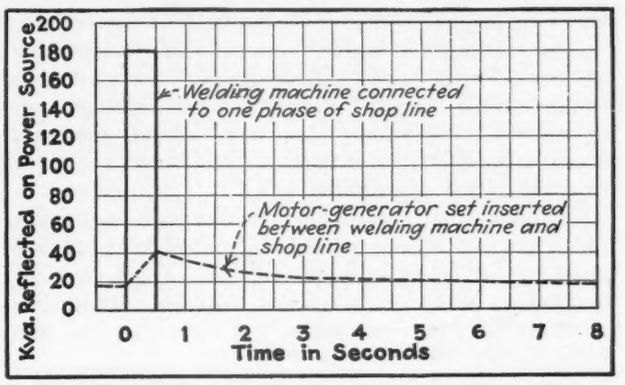
Another method of limiting electrical peaks, where flywheels are not suitable, involves use of the "shovel-type" generator. A d.c. generator operating a motor by the adjustable-voltage system (Ward Leonard) is equipped with a differential series field, a separately excited shunt field, and sometimes a self-excited shunt field. The differential series field serves to weaken the generator field with increasing load and thus cut down the output voltage. The kilowatt output rises to a designed maximum and then falls off to zero as the series field approaches the strength of the shunt field. This construction precludes peaks beyond the designed maximum, renders circuit breakers unnecessary since the current cannot become excessive, and makes it impossible for an unskilled operator to abuse the equipment.

Resistance welding loads present a different picture, since there is no motor to be driven. Spot welding requires from 5 to 22 kw. at 33 per cent power factor for from 0.3 to 1.9 seconds, depending upon the gage of the material. Butt welding takes as high as 75 kw. or 125 kva. so the two loads are similar in being single-phase shock loads with peaks all out of proportion to the energy consumed. Several methods are available for smoothing out welding loads, the best involving the use of a motor-generator set. This set equalizes the load on all three phases of the line, improves the power factor, and if a "soft" induction motor and flywheel are used, no abrupt or large load changes are imposed on the line.



A 20-sec. starting period for this 800-hp. super-synchronous motor driving the lineshaft in a flour mill keeps the demand down

Alternating-current motors, in general, are notoriously impetuous about starting; coupled to flywheel loads the result is a high demand for power and a severe wrenching of mechanical parts. Series or compound-wound d.c. motors can be made to keep the starting and accelerating loads within reasonable bounds. Often, however, it is not desirable to use d.c. motors; hence the supersynchronous motor may be considered.



Use of a motor-generator set to supply resistance welding machines changes the high peaks on single phase to a comparatively steady load balanced on all three phases

This motor has a rotatable stator with bearings independent of the rotor bearings. In starting, the stator is brought up to speed in the reverse direction and synchronized. Now all the pull-out torque is available for starting the rotor and its load while the stator is being brought to rest by a brake. While slowing down the stator and accelerating the rotor, the sum of the speeds of the two members is synchronous speed. By applying the brake gradually by handwheel or automatic motor gear, the acceleration of the load can be prolonged so that a predetermined demand will not be exceeded. Twenty seconds is common for starting a 160-ton tube mill in a cement plant. These motors are also used on flour mill lineshafts and mine ventilating fans of great size.

Starting induction and synchronous motors on full voltage is common practice, made possible by improved motors, greater stability of power systems, and a more lenient attitude on the part of utility companies. Where a high starting peak is objectionable there are two ways to mitigate it: use of reduced-voltage starting, or a motor designed to start on a low inrush current.

Reduced-voltage starting may depend upon an autotransformer, the common practice, or upon "part winding" starting. Large motors are often designed for this starting method which involves the energizing of two or more sections of the stator winding in succession.

Motors having inherently low starting current are designed with a double squirrel cage. The two sets of bars are disposed so that the high-resistance, high-torque set acts first with a gradual automatic transfer to the normal set through the decrease in reactance as the rotor comes

up to speed. This design makes it possible to use a simple, magnetic, full-voltage starter and obtain a current inrush comparable with that of a normal motor started by a compensator (autotransformer).

Motors of large size are sometimes installed to take care of increased loads in the future. This practice puts a heavy addition on the demand factor that enters into the power contract, provided the demand is determined by inspection or by calculation rather than by actual test. Triple-rated induction motors are available for such conditions. These Y-delta-connected, triple-rated motors were first applied in the oil producing field for pumping wells at various "allowable" rates. When installed and connected for the lowest rating, that rating is used in the demand factor. As the second and third ratings come into use the demand is correspondingly increased. Where a large number of motors are involved, the saving in power bills is appreciable.

Conditions that contribute to undesirable load fluctuations and which are amenable to control are: (1) concentration of heavy loads at one part of the day; (2) starting of heavy equipment by many non-coordinated operators; (3) heavy peak loads of a more or less accidental nature; (4) low power factor.

Special control systems are available which can detect the approach of emergency conditions and disconnect preferred loads in a certain sequence until the flurry is over, whereupon the loads are reconnected. Such devices relieve the switchboard watch from giving constant attention to the load. However, unless other precautions are taken, the frequency of operation might be inconvenient or cause loss of production. Operating procedure should be laid down with a view to minimizing the possibility of erratic load behavior and then letting the automatic device, if one is provided, take care of the unpredictable conditions.

Arrangement of load schedules to even off peaks and valleys is sometimes possible, particularly if there are electric furnace or other heating loads that can be shifted to night hours. There are cases where such shifts have materially helped production.

The practice of allowing a number of operators to handle equipment in synchronism is bad. Ship unloaders at lake ports have presented such a condition. One pacemaker would be faithfully followed by five other operators throughout the complicated cycle. A successsion of extremely high peaks often took the substation off the line and established demands that would have led to prohibitive rates. By staggering the sequence of operation, it is possible to obtain a relatively smooth load curve.

Supervised starting of heavy loads either by prearranged schedule or, better, by centralized control at the switchboard is accepted practice in large plants, particularly cement mills. In some cases all of the large motors are started from the switchboard upon exchange of signals with the mill operators. The switchboard watch, upon receiving a start signal, waits for a favorable load condition before making the desired start.

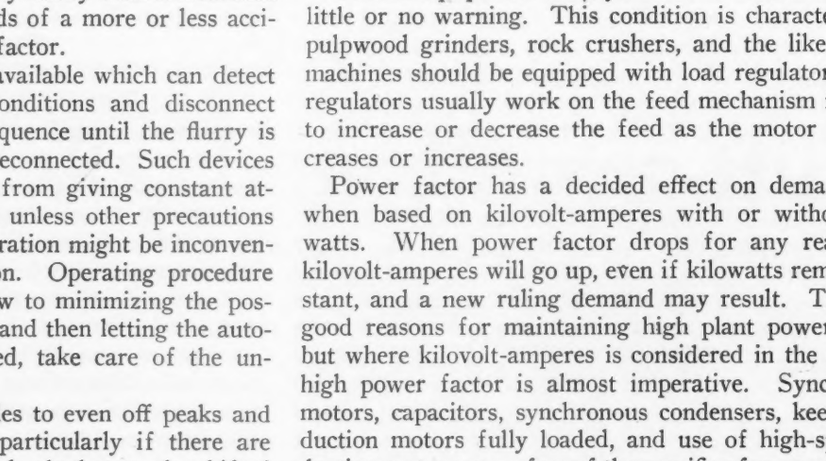
In conjunction with this practice, the switchboard attendant can when necessary shut down certain preferred machines or even departments, the selection being made on the basis of least interference with production.

A prolific source of peak and demand troubles is the hasty starting-up after a failure of power. Unless departments are scheduled or controlled they will all try to get going at once, with consequent skyrocketing of the load. A common practice is to disconnect all departments at the distribution switchboard and then upon the return of power put them back on at suitable intervals as indicated by the instruments.

Certain equipment is subject to severe overloads with little or no warning. This condition is characteristic of pulpwood grinders, rock crushers, and the like. These machines should be equipped with load regulators. Such regulators usually work on the feed mechanism in a way to increase or decrease the feed as the motor load decreases or increases.

Power factor has a decided effect on demand rates when based on kilovolt-amperes with or without kilowatts. When power factor drops for any reason the kilovolt-amperes will go up, even if kilowatts remain constant, and a new ruling demand may result. There are good reasons for maintaining high plant power factor, but where kilovolt-amperes is considered in the demand, high power factor is almost imperative. Synchronous motors, capacitors, synchronous condensers, keeping induction motors fully loaded, and use of high-speed induction motors are a few of the specifics for power factor correction. Automatic control of power factor is not uncommon.

Testing instruments should be used regularly, since only by this means can the condition of machines and their motors be determined. In the old days of steam engines and lineshafts, investigation of individual loads was handicapped. Today, with electric power so universally used, there is little excuse for any unit being operated in a manner to jeopardize the plant power rates, or to cause shutdowns when power is generated locally.



The plant power factor meter automatically controls the field of this synchronous motor. Through its ability to deliver from 300 lagging to 750 leading reactive kva., the motor keeps the power factor of the plant at unity

Now as to Stairs

Fred D. Hartford
Denver, Colo.

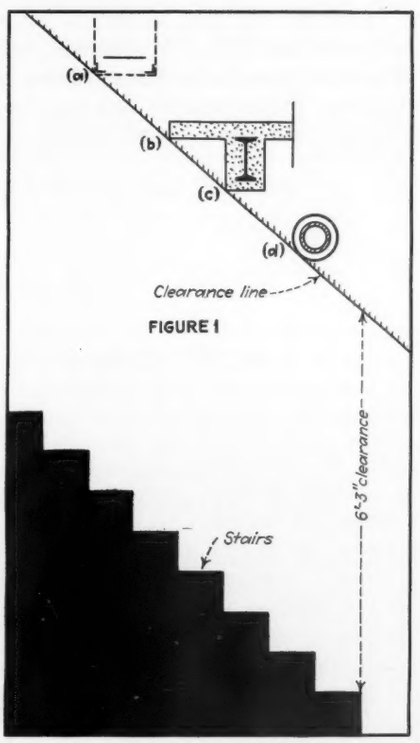


FIGURE 1

Figure 1. Indicated: Minimum clearance (see footnote 2); location of belt, floor slab, fireproofed steel beam, and pipe line for clearance. Figure 2. Indicated: Minimum safe tread, as required for descent. Relation of riser, tread, nosing. Figure 3. Showing that a 9-in. tread is also desirable for standing

STAIRWAYS are often unsatisfactory and sometimes unsafe because they have been altered to accommodate changes in lineshafts, belts, piping, spouts, and the like. Later they are deemed dangerous, time wasting, and fatigue producing, and the maintenance department has to correct them. In every case the code of the state should be followed when one exists. If stairways are not prescribed by law, the data given here can be followed confidently, in the interest of both safety and efficiency.[1]

Stairs, to be safe and efficient, must have (1) proper headroom; (2) proper ratio of rise to tread; (3) sufficient width; (4) a suitable handrail; (5) a sure tread surface.

HEADROOM—The minimum clearance line on a stair should be 6 ft. 3 in., measured vertically upward from the outer tip of the tread, and should be parallel to the stair slope as shown by Figure 1[2]. This clearance is determined by a person descending or standing on the stairs. It must be remembered that 6 ft. 3 in. clears only a man's head; if employees will customarily carry anything on their shoulders, the clearance should be increased accordingly.

There are also indicated by Figure 1 features of stair clearance that are sometimes overlooked: (a) shows a belt properly located with the *belt guard* at the clearance line; (b) indicates that the *bottom* of a floor slab, not the top, must be at the clearance line; (c) shows that a steel beam which is fireproofed should be set back so that the fireproofing will be at the clearance line; (d) indicates a pipe line elevated above the clearance line so that any pipe flanges will clear.

TREADS AND RISERS—*A man can easily climb* a stair steeper than 45 deg., but he finds, as everyone knows, that descending it is an entirely different matter. As the descent determines the overhead clearance line, so also does it fix the minimum safe tread width of 9 in. as shown by Figure 2. Figure 3 indicates that a 9-in. width is also desirable in case a person wishes to come to a standstill, although the actual contact of the foot when ascending may be only 3 or 4 inches. From these figures it is evident that the minimum safe tread of 9 in. refers only to the space, and that the material of the tread itself may be 8 in. or even 7 in. wide, measured back from the outer edge.

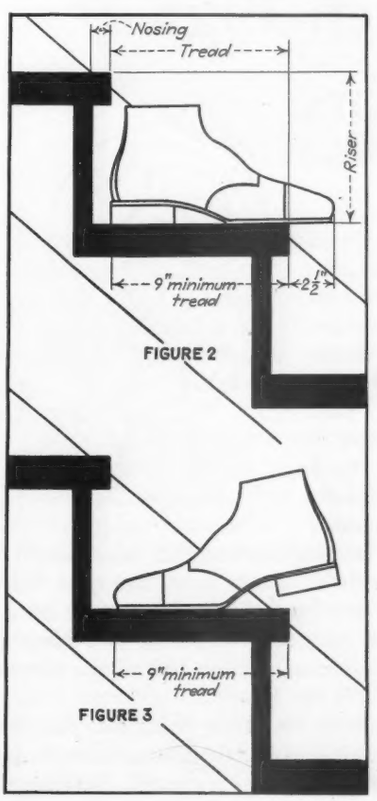


FIGURE 2

FIGURE 3

The maintenance department that wishes to keep a reputation for easy stairs will not depart far from the two rules ordinarily in use. Either gives about the same result:

Tread + Rise = 17 in.

(2 × Rise) + Tread = 25 in.

A very good rise and tread for plant stairs is 7¾ in. and 9¼ in. This ratio gives close to 40-deg. slope. A run of stairs and, preferably, all stairs in a building should have the same risers and treads throughout. Winders and circular stairs should be avoided unless space limitations make no other stairs possible. The

[1] See also Data Sheet No. 3, *Maintenance Engineering*, August, 1929.

[2] Some authorities recommend several inches more to be certain of clearance for a tall man wearing a hat.

narrow tread and the long vertical drop at the inner edge of such stairs render them extremely dangerous.

If the stair riser is closed, as it should be if the soffit is plastered or if there is traffic under the stairs, then the nosing should be about 1 in. in order that the heel of a person descending and the toe of one ascending will have clearance. Figures 2 and 3 illustrate this.

When women employees are to use the stairs, the slope should be conservative. In addition the tread should be solid, not a grating, and the riser should be closed. I once had repaired and decorated a room over a storehouse for a plant cafeteria. Access to the room was had by an exterior stair with steel grid treads. The women employees of the plant refused to use the cafeteria until the stair treads and risers were made closed.

WIDTH OF STAIRS—If there is to be continual passing of two employees on a stair, or if delicate apparatus is to be carried up and down, then the stairs should be at least 36 in. wide. For a stair giving access to control valves, observation points, and the like, a 20-in. tread width will suffice. However, the clearance between handrails should never be less than 24 inches.

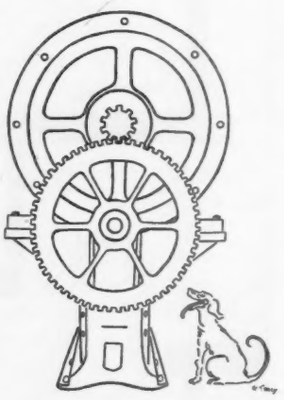
STAIR HANDRAILS—The top of the stair handrail should be 32 in. above the tip of the tread and the knee-rail should be 17 in. above the same point. A welded pipe handrail with pipe newels is better than one of angle iron, because it offers a smoother guide for the hands and looks much more workmanlike.

TREAD SURFACE—One other precaution should be taken. In certain locations water, oil, or other slippery substance may cause danger of slipping. In such cases the tread should be provided with an abrasive or other non-slip surface. Worn treads, causing unevenness, and splintering also must be guarded against.

▼ ▼ ▼

Why Such Big Motors?

D. W. Roberts



I HAVE often wondered how and why the machine-tool manufacturers are so ample in their recommendations as to the motor capacity required for driving their machines. Last evening as I was having a smoke before turning in, I thought of Mike Spazic. The picture of Mike's broad face recalled a most striking instance of this liberality.

Many years ago a 10-ft. gang press had just been ordered to punch 50 holes or so in a long piece of 2- or 2½-in. Z-bar. The long stock required two men to handle it, and with the clamping time and all the output would be only 100 pieces per hour.

The press manufacturer had been furnished data on the number and size of the holes, the thickness and carbon content of the stock, and the expected production. He was asked for a recommendation as to the required motor capacity.

The reply stated that the press would require 26 hp., and a 30-hp. motor was recommended. As we already had a 25-hp. motor driving three similar belted presses, a number of punch presses, and a shear or two in a group, this recommendation seemed excessive. Further, it seemed quite unnecessary to use a 30-hp. motor on a 26-hp. load which had a heavy flywheel to do the actual punching and at least 95 per cent idle time. On the other hand, I had little idea how much torque would be required to start the press when the bearings had been overhauled, or when the grease was frozen in the bearings on a winter Monday morning. Finally I ordered a 15-hp. motor for the job.

The motor ran as cool as though it had no load at all. A test showed, however, that by the time the motor had brought the flywheel up to two-thirds or three-quarter speed it was doing around 50 h.p. The load dropped off rapidly as the motor approached full speed. I had thought quite a lot about this job between the time that the motor was ordered and the erection of the press, and I realized that this fact indicated nothing as to the horsepower requirements of the job. Any motor would exert the maximum torque of which it was capable while bringing a heavy flywheel up to speed. If I had installed a 30-hp. motor it would have put power into the flywheel twice as fast and brought the machine up to speed in half the time.

Years later, high-starting-torque, high-slip motors were developed for flywheel jobs—high-resistance rotor motors they were called in those days. I read about how they slowed down when the load hit them, and let the flywheel do the work. I wanted to try one somewhere. These gang presses, of which there were three installed by this time, appeared to be a logical application.

A little figuring indicated that a 5-hp. high-resistance rotor motor would start almost as heavy a load as a 15-hp. standard motor started with a compensator. We bought one. It started the load apparently without effort, and ran cool. We installed similar motors on the other two presses, and all three ran well "forever after."

You may wonder what Mike Spazic had to do with all this. So far as this little story is concerned, the fact that I thought of Mike caused me to tell it. There was another experience with these presses in which Mike played a part. I'll tell it next month or just as soon as the editors let me in again.

Principal Developments in Welding Equipment

Previous articles in this series on improvements in important industrial equipment have covered Plant Service, Mechanical Power Transmission, Electrical Control, Distribution, and Motors

Arc Welding Rods

Much progress has been made in the development of the shielded-arc welding process which employs heavily coated rods. The coating is of such nature that the metal inside melts faster than the coating, so that the latter projects beyond the arc, shielding it from contact with the air. As the coating burns or vaporizes, it forms a gas which serves as a deoxidizer and blanket to keep the atmosphere from the weld.

Present tendency in welding practice is toward the use of rods requiring higher currents and potentials, and frequent changing of polarity of the welding current. Such rods include high-carbon steel, special alloy steel, and practically all coated rods. They demand extra heat that can be supplied only by machines especially designed for welding with currents as high as 750 amperes and potentials up to 40 volts.

During the past three years welding rods have been developed to the point where a suitable type is available for every application. A rod is available which gives satisfactory results in welding 18-8 chrome-nickel steel. The flux coating produces a non-reactive gas which surrounds the hot metal and prevents the oxygen of the air from attacking it and forming oxide. Heavy slag forming on the weld acts as a protective agent as the metal cools.

A new high-speed welding rod has a coating which is not affected to any appreciable extent by atmospheric conditions or moisture.

Rods are available that can be used to produce a deposit on tools and other objects, a metal which can be ground to a cutting edge. They are suitable for reinforcing parts of machinery that must withstand heavy wear, and have proved especially useful for chipping tools or parts of machinery which have to withstand exceptionally heavy duty or which have to resist deformation under heavy stresses.

Heavily coated rods for welding mild steels have been improved in ductility, tensile strength, speed of application, and resistance to corrosion.

Rods for welding non-ferrous metals have also been subject to much improvement. One for welding sheet or cast aluminum has been made. It is essentially a silicon-aluminum alloy designed for either metallic or carbon-arc welding. The coating prevents excessive oxidation and dissolves any aluminum oxide formed, and the weld can be polished satisfactorily with practically no discoloration. Rods are also available for building up worn manganese parts.

With the oxyacetylene process, bronze welding has become one of the most important methods used, because it permits metals having a higher melting point than bronze to be joined with a minimum application of heat. It is also popular for building up wearing surfaces. A bronze welding rod is available with which welds joining steel parts can be made having tensile strengths between 56,000 and 60,000 lb. per sq.in.

An important application for bronze welding, where large deposits of bronze are built up in sections, is in the repair of cast-iron machinery frames and bases.

A welding rod made from copper-phosphorus alloy is available. The phosphorus prevents the oxidation of both the copper and the surface being joined, thereby acting as a flux and producing a sound and dependable joint.

Oxyacetylene Welding and Cutting Equipment

The most important development in oxyacetylene applications is flame machining. Only partially commercialized, this process has already established itself as an important tool in many machining operations.

Improvements made in semi-automatic oxyacetylene welding promise to effect further savings. This process has made possible the joining of unusually thin tubing

which previously could not be very satisfactorily welded.

Refinements in the design of gas welding tips have brought increased convenience by making it possible to combine various tips and stems for every welding application.

Use of oxyacetylene for cutting has also been increasing. Improved types of blowpipes are available which increase cutting facility and minimize the possibility of flashbacks.

Improved regulators are available for maintaining the proper mixture of oxygen and acetylene. Devices also may be had for shutting off the gas while the operator is setting up the work. No gas is wasted while readjusting the flame. As soon as the welding torch is lifted from the torch arm, a neutral flame is obtained.

Progress has been made in acetylene generators. One portable low-pressure automatic unit available weighs only 38 lb. Carbide is not exposed to water or moisture at any time until used. The valve controlling the carbide may be locked, or the entire carbide hopper removed when the generator is transported.

For supplying large volumes of acetylene in plants where welding and cutting are used extensively, and where oxygen and acetylene are piped to stations convenient to operators, improved, non-automatic, stationary acetylene generators are available. By means of a booster system, acetylene may be delivered to the shop piping system at 50 lb. per sq.in., the permissible limit of pressure.

Arc Welders

Improved designs of arc-welding generators have been made available in rapid succession during the past three years. Stationary and portable, gas-engine driven and motor-driven, automatic and manual, and multiple- and single-operator units may be had over a wide range of capacities and prices.

Changes have been in the direction of higher voltages, more stable current, and greater facility of control. This modern equipment, with the development in welding rods, has resulted in 200 to 300 per cent faster welding.

Demand for higher welding current, used with large-sized metallic and carbon rods, has resulted in the design of a single-operator, variable-voltage machine with a current rating of from 180 to 750 amperes.

A feature of practically all modern welding sets is almost instantaneous voltage recovery from short-circuit to open-circuit voltage with, consequently, a quickly responsive arc.

Modern control accessories have made possible the dual-voltage, constant-arc machine, and have greatly simplified the control of welding current for every job. On one machine the dial rheostat unit can easily be removed, connected to the machine with ordinary lamp cord and located near the operator. This feature simplifies control of the machine when it cannot be placed near the job. Such machines are widely used for production, maintenance, salvage, and general job welding, where suitable electric power supply is available near the work.

Many welding generators have excessive exciter capacity, so that they may be used as a source of power for operating lights, electric drills, and other tools.

Welding sets utilizing an a.c. arc have also undergone development. An a.c. set has been designed which is especially suited to the welding of thin-gage material such as is used in the manufacture of metal furniture, sheet-iron cabinets, and in job and garage repair work. Either bare or coated rods may be used. Many of the ferrous-alloy materials commonly applied with reversed polarity direct current may be used with this welder, which has also been used successfully in welding aluminum. It consists of a special self-cooled transformer, short-wave arc-control system, and current-regulating devices.

Automatic and semi-automatic welding units have been increasing in popularity. With these machines the electrode is manipulated by a device which starts the arc, holds it at a predetermined length, and feeds the rod forward as it is consumed. The welding head, which holds the rod, may be mounted stationary and the work moved under it, or it may be mounted on a carriage and moved along the seam to be welded.

On the semi-automatic machines the operator guides the electrode over the work by hand. The wire-feeding device is usually motor-driven, supplying wire continuously to the arc. One welder of this kind on the market is equipped with a gear shift for obtaining approximately the required rate of wire feed, the final adjustment being made by means of the motor field rheostat.

Automatic welding machines are provided with a clamping mechanism for holding the work. The carriage is set at one end of the seam, the start button pressed, and the remainder of the operation is allowed to proceed automatically. Speed of feeding is usually controlled by the voltage across the arc, which varies with the arc length.

An automatic machine has been developed for atomic-hydrogen welding. The atmosphere of hydrogen surrounding the molten metal prevents the formation of harmful oxides and nitrides, and produces a more ductile weld. The atomic hydrogen process is especially suitable for welding thin materials, alloys, and non-ferrous metals, and for making smooth, ductile welds in steel of any thickness.

Dual-Voltage Connections for Induction Motors

Three-phase delta series and parallel connections, twenty to twenty-four poles

(Concluded from the November, 1933, issue)

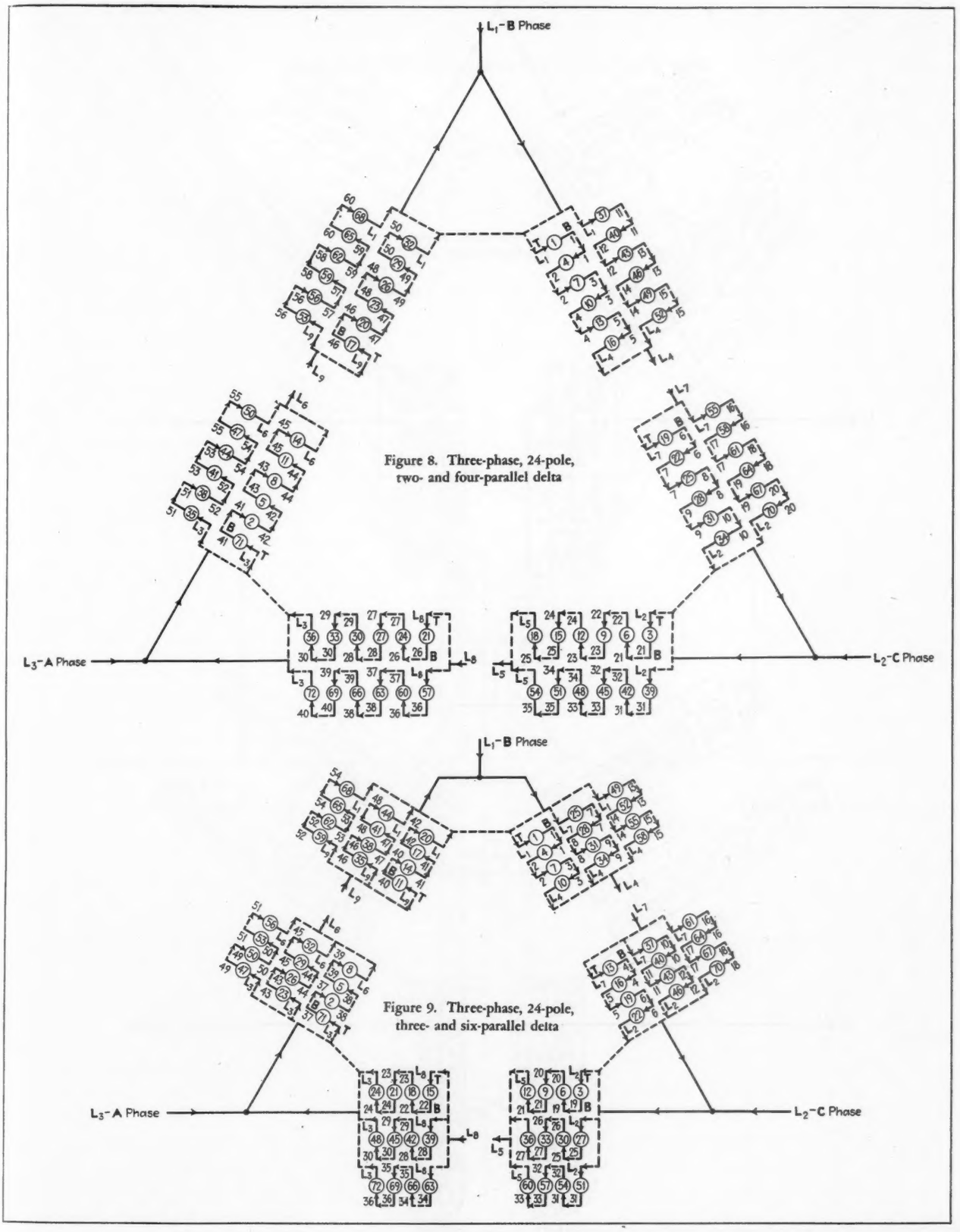


Figure 8. Three-phase, 24-pole, two- and four-parallel delta

Figure 9. Three-phase, 24-pole, three- and six-parallel delta

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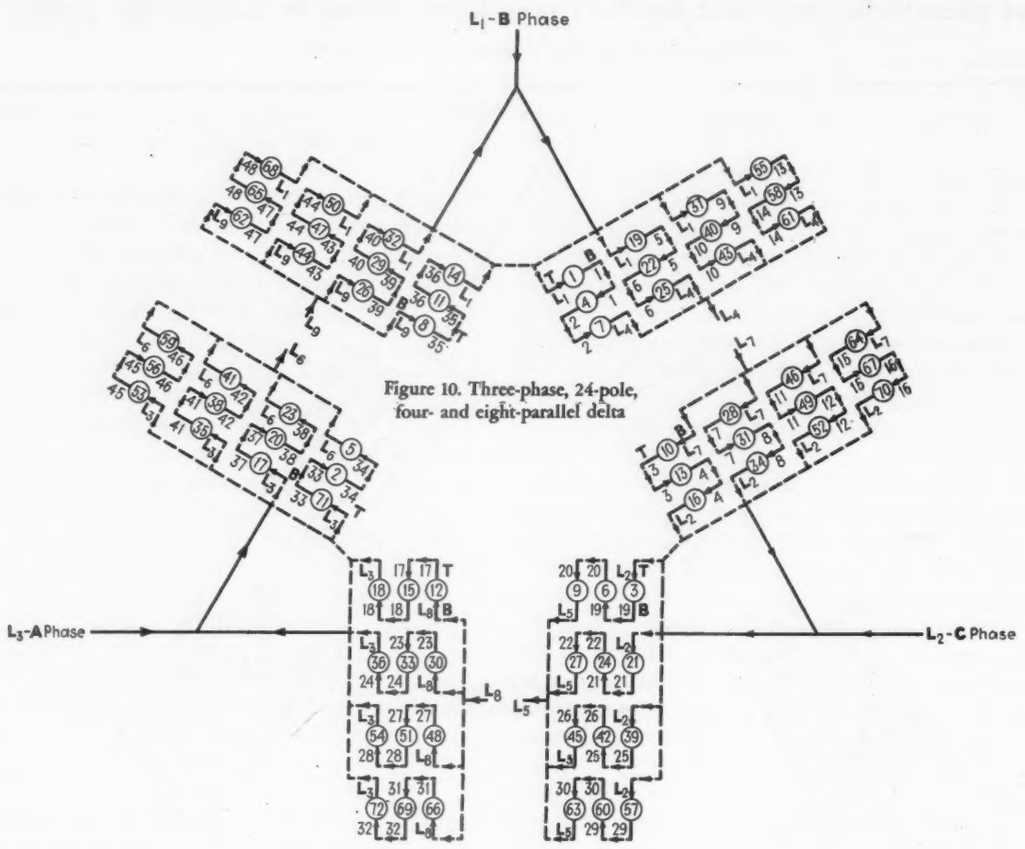

Figure 10. Three-phase, 24-pole, four- and eight-parallel delta

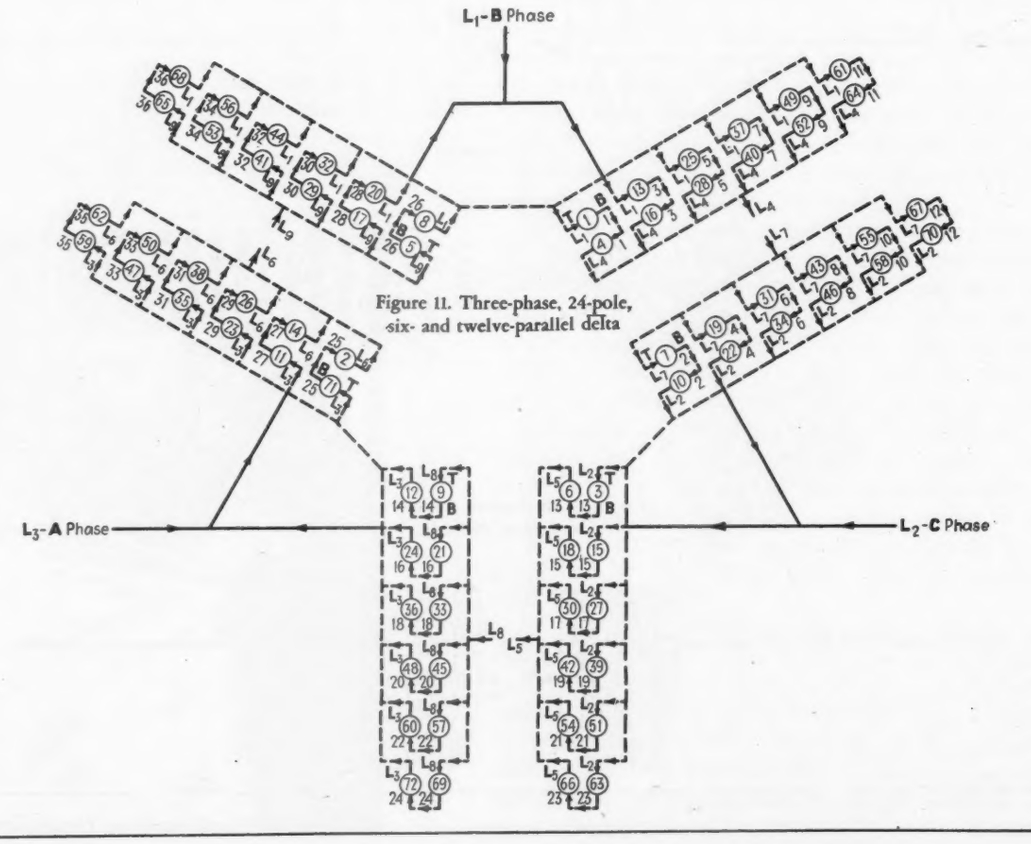

Figure 11. Three-phase, 24-pole, six- and twelve-parallel delta

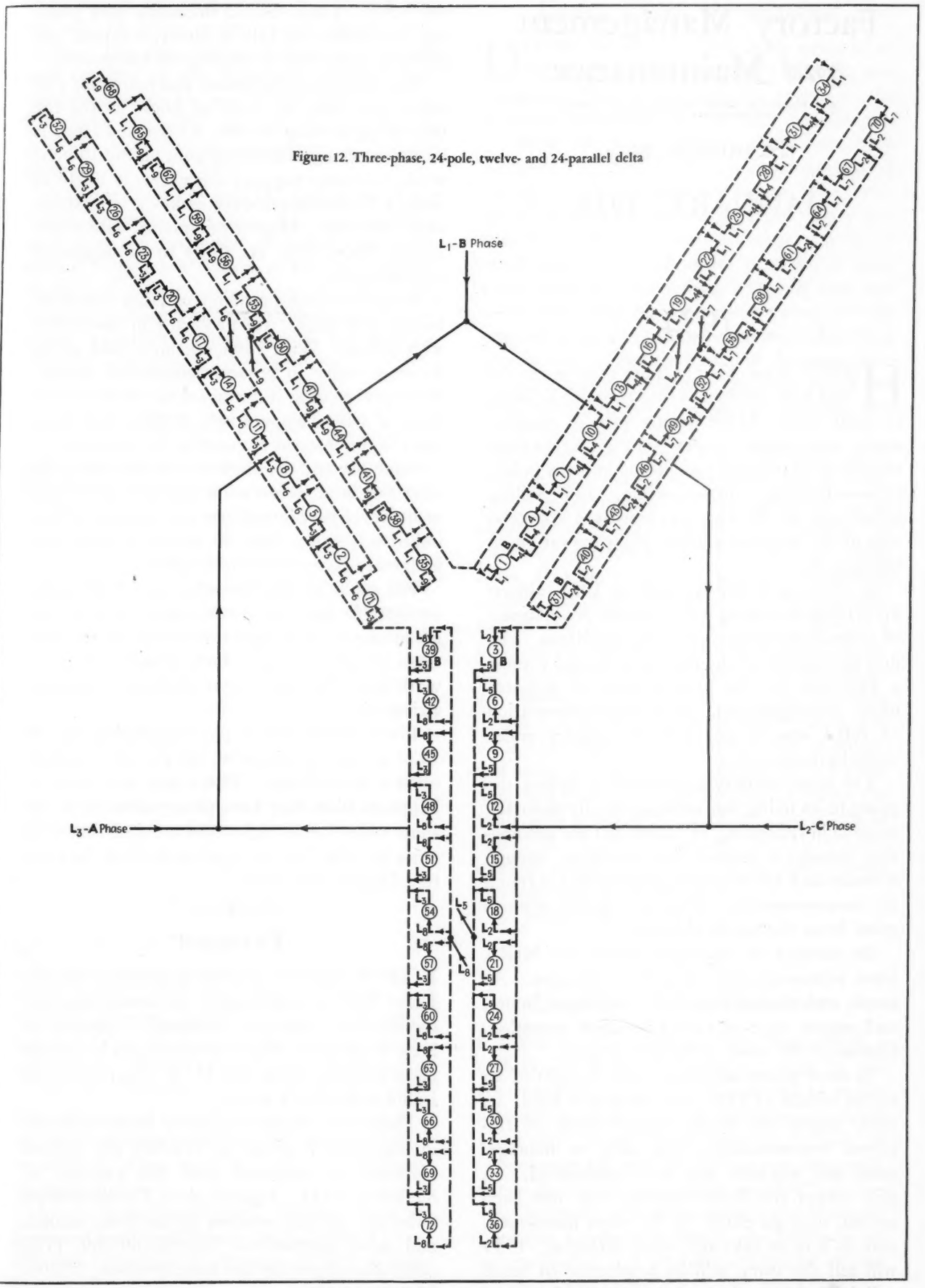

Figure 12. Three-phase, 24-pole, twelve- and 24-parallel delta

Previous installments appeared in the November and December, 1933, issues

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

L. C. MORROW, Editor

JANUARY, 1934

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1934

HAPPY New Year! This time it can be said with confidence that the wish is likely to come true. More people back at work—more purchasing power—more purchasing; standards of practice established in many industries—chiseling, throat-cutting, and selling below cost on the way out; increased appreciation of the need for efficient plant operation on the way in.

In 1934, as in the last half of 1933, almost everything industrial will be under the influence of codes, code authorities, and compliance. The first six months of the new year should witness a fair test for the greater part of industry under self-regulation. (Christmas expectation of NRA was 85 per cent of industry under codes by January 1.)

The steel industry apparently is finding the going to its liking, has enthusiastically endorsed its code in requesting an extension; the automotive industry's request for extension, though without such endorsement, implies that it found no insurmountable obstacles; good reports come from the textile industry.

Six months of experience under the NIRA have witnessed some important changes. As usual, and normally so, labor relations, hours, and wages have attracted greatest attention, furnished the most attractive targets.

In some plants unionism, little thought of up to the middle of 1933, has taken firm hold. In other plants the works council form of employee representation, new alike to management and workers, has been established. In still others the labor question has not been solved, may go either of the ways mentioned, stay as it is, or take still other direction. 1934 will tell the story, will be productive of much enlightened cooperation between the hirers and the hired. Labor Board decisions, now pending, will make for fair or cloudy weather, depending upon who is reading the barometer.

The forty-forty maximum and minimum (40 hours per week, 40 cents an hour) is for the time being holding its own. Organized labor is on record as sighting its big guns on the 30-hour week, has some support elsewhere, is likely to press a bit unless recovery makes a long stride early this year. Higher minimums, with maintained differentials, are likely to be simultaneous objectives.

Added to these problems of labor relations, hours, and wages, are problems in connection with prices. With costs up, how hold prices down in order to possess competitive ability? How prove costs, if necessary to refute accusations of selling below cost? In fact, how *know* costs in the interest of running the business?

Some part of the answer to these cost questions lies in modernization of plant and equipment, some part in uniform cost systems within industries, some part in standard costs and budgetary control within the plant.

We could go on, list other problems, point out specific jobs for management, production, maintenance. But these are enough to stir anyone's imagination as he looks ahead at a year's work with the purpose of giving it a general sizing-up.

It's to be the job of plant operating men in 1934 to put the pieces of the puzzle together, make a nice picture. These men are never so happy as when they have plenty of work to do, some objective in sight. So we feel that it is quite in order for our readers to look forward to a Happy New Year.

•

Turnover

LABOR turnover doubled in the third quarter of 1933 as compared to the second quarter, reports the American Economic Institute of New York City. The Institute bases its survey upon statistics from the U. S. Department of Labor and other sources.

Estimated annual voluntary labor turnover in industries is given as 176,000 per million workers, as compared with the average of 83,000 in 1933. Figures given for the annual quits per million workers in the first, second, and third quarters are 54,000, 89,200, 176,000; discharges for the same periods, 15,200, 20,800, 31,200.

These are alarming figures, even though they are not likely to prevail after things settle down. The uncertainties and misunderstandings incident to the Recovery program have been responsible for part of the increases. The remainder probably are just the natural increases that always accompany a business revival.

So many displacements and replacements are costly, whatever the cause. The cost of hiring and firing is variously estimated, having a spread from a few dollars to several hundred. Purely on a cost basis, therefore, the right kinds of personnel officers, employment departments, and training departments can pay for themselves in reduced labor turnover.

•

Who's Next?

BECAUSE we've been hearing since 'way back when that the woodworking industry is "backward," it becomes a distinct pleasure to present a report of real progress in one division of that field.

For years plywood manufacturers have faithfully taken most of the moisture out of wood—and then, in the gluing, put some of it right back in. Now research comes along with the hot-press-dry-glue process which adds no moisture, capitalizes instead on the small amount that is left, puts it to work. Gluing hours become minutes. The product is better.

So research finds simple ways to overcome age-old handicaps. And so a backward industry shows the way to others.

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Vacations

SOHIO (The Standard Oil Company of Ohio) has adopted a formal company policy calling for vacations with pay for workers, effective January 1. Success in securing acceptance for the plan is attributed to the joint efforts of the various Sohio unit councils.

The plan provides one week's annual vacation with pay to every Sohioan with one to five years of continuous service; two weeks' annual vacation to those with five years or more of continuous service.

Are those Sohioans glad? Do they have an increased feeling of loyalty to old Sohio? And will they be at least moderately careful of quitting jobs?

Codes, Costs, Obsolescence

DIVISION Administrator Muir wrote us an editorial, although he didn't know he was doing it. Here it is—from his speech to the National Machine Tool Builders Association:

"Now that many industry codes have been accepted, business finds some manufacturing executives are sad, some are happy. The latter are those who have low-cost plants. They find they have an economic advantage. Keep in mind that the NIRA codes prohibit an individual manufacturer selling below *his own* cost—but not below his competitor's cost. So the low-cost plant can use this economic advantage several ways—might even sell at the same price as its competitors and use the extra profit for more salesmen, for redesign of products, for improved quality.

"On the other hand, if the high-cost plant, which has agreed not to sell below its own cost, too, refuses to see the advantage of using modern, up-to-date machinery, continues to tolerate obsolescence, determines to retain high costs, that is virtually a decision to commit commercial suicide. Now suppose you persuaded this plant to modernize, to construct a new, efficient plant, to install modern equipment and methods, to reduce costs to competitive levels. Then this plant could survive, then it could continue to provide employment and could continue to contribute to the economic and social welfare of its community. In addition, this plant would be helping to revive the prostrated industry of capital goods—would be doing its share of putting the 10,000,000 workers normally employed in the capital goods industry back to work."

So mote it be.

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Employee Representation

ONE CANNOT read "Ten Years With a Works Council" (opening article of this issue) without becoming enthusiastic as to the possibilities under such an employee representation plan. Then immediately one is likely to wonder why not more companies are using such plans. But is this assumption justified?

In its report of a recent survey, the National Industrial Conference Board, on the basis of reports from 3,314 manufacturing and mining concerns (employing 2,585,740 wage-earners)

shows that 45 per cent of the employees deal with their employers through plans of employee representation. It must be remembered, too, that small plants do not lend themselves well to the council form of employee-representation. Note the summary contained in the report:

"Two definite conclusions may be drawn. In the first place, it is clear that individual bargaining has not in any way been eliminated by Section 7(a) of the Recovery Act. There are too many companies in which this method has proved satisfactory over a long period of years to permit of its elimination. Many of these companies, moreover, are not of sufficient size to call for a representation plan. It seems likely, therefore, that individual dealing will remain the basis of employer-employee relations in a majority of industrial establishments, especially since a large proportion of such establishments is in the small-size class. The second general conclusion is that employee-representation plans have expanded greatly, both in number of companies affected and, particularly, in number of employees covered. Whether or not 45 per cent of all wage-earners in manufacturing and mining industries deal with employers through such agencies, as is indicated in this study, or whether, if data for all wage-earners were available, the proportion would be found to be somewhat smaller, it is obvious that large numbers of employees have elected to bargain collectively by means of such plans."

Our own conclusion is that most large plants and some plants of medium size should canvass the possibilities of collective bargaining by means of the joint-council type of employee representation. Certainly the plants that have made use of it for the last ten or fifteen years are relatively unworried now in regard to the "labor situation."

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Borrowing for Equipment

GOOD NEWS for the capital goods industries lay in the announcement last month that PWA funds would be loaned to the railroads at 3.90 per cent (average); also in the requests from railroads for forty-four millions.

According to our Washington correspondent, folks having a hand in this plan say that if the thing takes hold it may run to a billion dollars, become a real incentive to capital goods.

Possibly the railroads, moved by the inflation wrangling, feel that it is both safe and profitable to turn dollars into equipment, on the basis that dollars spent on modern equipment are insured against devaluation.

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Index Available

UPON request a copy of the index of the editorial contents of FACTORY MANAGEMENT AND MAINTENANCE for 1933 will be sent free to any subscriber. This index will also cover the two 1933 numbers of FACTORY AND INDUSTRIAL MANAGEMENT and MAINTENANCE ENGINEERING which preceded the consolidation.

Although copies of the index will not be available until about February 15, we shall appreciate receiving requests as far in advance of that date as possible.

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Problems and Answers

MANY NEW problems have arisen to confront maintenance departments during the year that has just passed. Marked revival of industrial activity brought the problem of quickly restoring idle, oftentimes neglected, machinery to service. In many cases well-balanced seasoned organizations had been broken up and skeleton forces were called upon to do a man-sized job unaided, or augmented by a few newcomers.

The shorter working week prescribed by industry codes has increased the value of preventive maintenance. With a 60-hour working week if a machine were down for an hour it meant the loss of one-sixtieth of the working time; with a 40-hour week, an hour of lost time represents a greater proportional loss than it did before.

If problems have been increased, however, maintenance has been given new tools with which to meet them. Important advances have been made in every type of equipment that the maintenance department deals with. New testing equipment, better motors, controls, power transmission devices, and many other things have been made available. Details have been given in our Equipment News pages.

Some of these devices will facilitate maintenance work; others will reduce the amount of maintenance required, and help to pay their cost by increased reliability and efficiency.

All have a definite place in every plant that expects to meet present conditions and competition successfully.

· FACTORY FORUM ·

A new question is presented herewith, and readers' discussions of previous questions are published. Write down your opinions and send them to the editor. Answers published will be paid for

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ANSWERS TO PREVIOUS QUESTIONS

What of Works Councils?

(Question presented in the December issue)

WORKS COUNCILS certainly are desirable provided they are truly representative of employees and employer. The successful employer realizes that the question of employee welfare is also a question of his own welfare; therefore it is his duty, through proper representation, to cooperate with the men.

In the case of most unions, the employer must do business with paid business agents who do not thoroughly know the employee or employer viewpoint, and most adjustments leave a dissatisfied taste with both.

If works council representatives are properly picked for their level-headedness, open-mindedness, and ability to think for the men they represent, then the employees certainly can have no objections to the employer picking executives with the same type of ability to represent him.

I cannot see where a council that has nothing to do with hours or rates can be any good to the employees. Nor do I believe that a shop that tries to combine council and union will ever have harmony.

The works council is, I believe, the ideal situation, and for the few that have fallen short of the mark through improper handling there are hundreds that are successful.

CHAS. R. WHITEHOUSE
Electrical Engineer
The Holtzer-Cabot Electric Company, Boston

WHEN THE type of employees is of the more tractable class, a works council is desirable mainly as a defense against outside organizers or agitators. Some fourteen years ago, when Industrial Democracy was the mode, an installation was made, the consulting advisors and the management using my popularity with the workers as the assurance that they would have a "Square Deal." It functioned well for about nine months, mainly because we kept the radicals pacified by letting them think that they had something to say about the management. Inside of six months after I left, it flopped.

Whether or not the management is honest in its desires and efforts soon manifests itself. Generally speaking, except for the Dennison Company and possibly two or three others, the managements were using Industrial Democracy as a stop gap to stall off pay raises, etc. when the employees had the upper hand. It was strategy to handcuff the radical element, although it proved to be only paper handcuffs.

Good oil and good water will not stay mixed for any appreciable length of time. Neither will works councils and real unions work together successfully for any period of time.

Works councils, unless they can discuss and act on wages and hours, are just shadow boxers, nothing more. Abraham Lincoln's, "You can fool all the people, etc." is still being blindly practiced by both management and employees.

E. E. GAGNON, *Management Engineer*
Manheim, Pa.

IN PRESENTING an opinion relative to works councils it is necessary to give an unbiased discussion of employer-employee relations. The history of past years has shown us that a reduction of the manufacturing and consumers' costs of an article has produced its increased salability: further, that these decreased costs have been the cause of the growth of industries to their present-day proportions. Higher production speeds led to reduced costs.

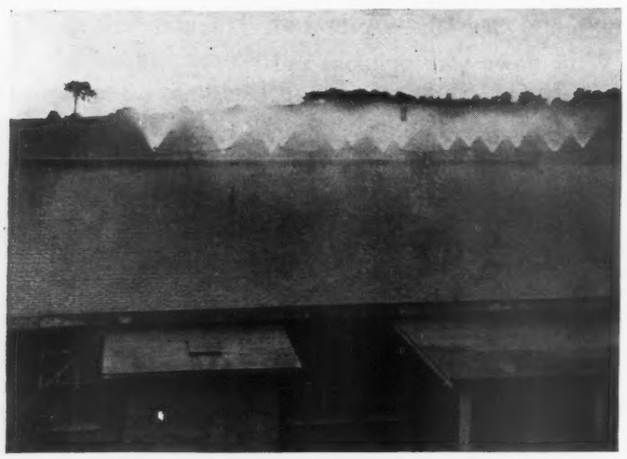
The inauguration of the piece-rate system at first led the employee to faster and more efficient work and resulted in reduced costs. Its abuse, brought about by a demand for still lower costs and consequent periodic reductions in piece rates, led to the destruction of employer-employee cooperation. Employees organized and formed unions which demanded decent wages, reasonable hours, and better working conditions. The spirit of cooperation, however, was and still is in many cases, forgotten, as is made evident by numerous strikes.

Frederick Taylor conceived scientific management as it is known today. Employer-employee cooperation is the fundamental basis, for under it the worker's earning capacity increases with his productiveness and efficiency. Employers using this system and incentive wage scales have practically no labor troubles, for the fair-minded employee who works under these conditions has no desire to make unreasonable demands on his employer.

Works councils under such systems may become a real benefit to both employee and employer provided they are

(Continued on advertising page 36)

• SHORTS FOR MANAGEMENT FOR MAINTENANCE •



They Use the Roof To Cool Water

SOURCE, The Serve Ice Co., Brewster, N. Y.

Where the water supply is limited and lots of it is needed for a condensing system, use the roof. The Serve Ice Co., Brewster, N. Y., does it; sprays the water into the air to cool it, collects it again like rain water, and uses it over and over. No special roof is needed. But gutters must be generous and on both sides, because the wind sometimes blows all the spray one way. The Serve Ice set-up can handle 600 gal. per min., cooling the water from 90 deg. F. to within 5 deg. of prevailing wet-bulb temperature. The water is used for cooling ammonia condensers and a diesel-driven compressor.

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Automatic Control for Steam Heating System

WILLIAM ANDERSON, Brooklyn, N. Y.

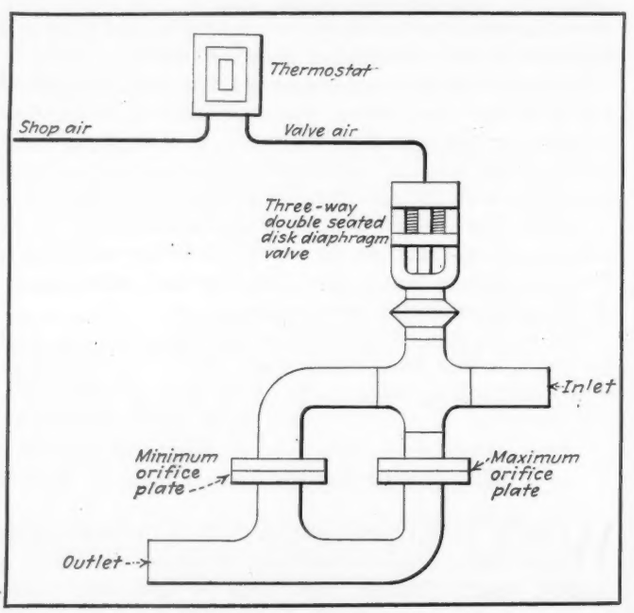
The accompanying sketch shows a simple and inexpensive means of automatic control for a heating system, a group of radiators, or a single radiator. This control is not offered to supplant automatic systems of control now available, but it is recommended as a means of keeping an assigned space heated at an even temperature, despite the sudden heat gains and losses, some temporary and some permanent, that accompany process operations. Because it is seldom that a building needs the maximum design steam flow, much time is wasted in trying to keep the steam supply balanced.

The control offered here is a diaphragm-actuated spring-loaded, three-way, double-seated and faced disk valve that provides the maximum or minimum flow of steam through the proper orifice, as called for by a key room thermostat. One flow of steam supplements the other, according to the thermostat making and breaking contact. In other words, when the valve is in its normally open position, the maximum flow of steam is available through the lower port of the valve, the air pressure being relieved from the diaphragm. At the allotted temperature rise, the thermostat acts to admit the air pressure on the diaphragm, which action closes the lower valve port and opens the upper port for a minimum flow of steam.

The control is flexible, in that the supply of steam may be throttled at the source of supply, or the air supply may be shut off entirely and the steam balanced by hand at the source of supply.

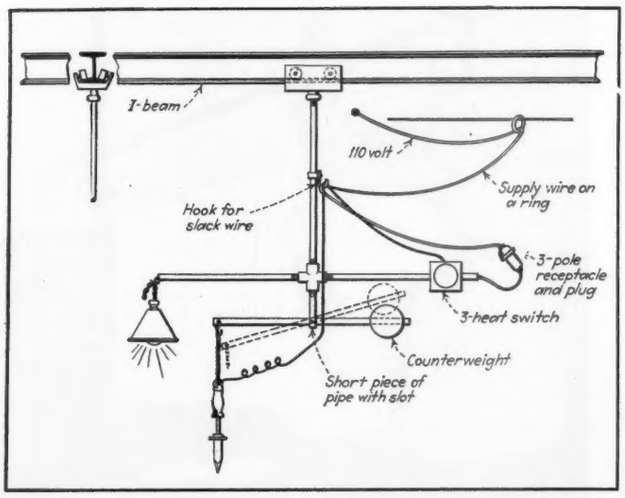
The proportioning of the steam supply is accomplished by two $\frac{3}{16}$-in. brass orifice plates, inserted between the flanges. The orifice plate for the minimum flow may be proportioned to permit the flow of enough steam to provide adequate heat in mild weather, or it may be proportioned to pass any fraction of the maximum design flow of the system that is deemed necessary. The maximum flow orifice should be designed for about twenty per cent greater steam flow than the maximum design flow of the system for a quick pick-up.

Considerable economy in reduced steam consumption may be obtained with a studied application of the tapering action of this control, especially in a vacuum return line system.



If compressed air supply is not available, a motor operated valve with a suitable thermostat may be substituted in place of the spring loaded diaphragm.

The valve and thermostat may be purchased on the market. The valve is sold for the purpose of controlling drinking water temperature in conjunction with another type of thermostat. The thermostat used with this control is manufactured to control the air-operated damper motors of ventilating ducts.



Suspended Soldering Iron Is Easier to Handle

J. H. Sauve, Temiscaming, P.Q., Canada

Soldering armature clips or risers can be expedited by suspending the soldering iron over the work. The arrangement we use is shown in the sketch. The support is made of pipe and is hung by a swivel suspension fitting from a small trolley which rides on an I-beam that carries the work. On one end of the crossbar is mounted a three-heat switch for the soldering iron. A hook on the other end carries a drop light suspended from a chain to permit easy adjustment.

The soldering iron is also hung on a chain, so that its height can be adjusted to the different sizes of rotors, suspended from one end of a balanced beam provided with a counterweight. The weight is adjusted so that it will just lift the iron off the work, when released.

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"Assistant to the Salesmen" say buttons worn by employees of operating and sales departments in a Philadelphia plant. They use title in writing to salesmen. Good psychology—works both ways.

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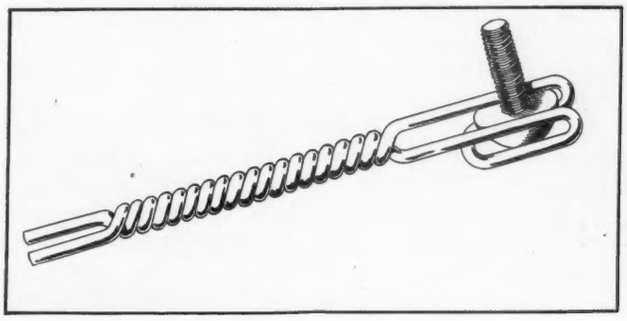
To Reach Places Hard to Reach

Chas. H. Willey, Penacook, N. H.

One often has to insert a screw or a rivet in some place that is hard to "get at," as for example in the tube of a hollow drive member. A very satisfactory device that answers this purpose can be made from twisted wire as shown in the sketch. The tension of the wire at the loop end is strong enough to hold the screw or the rivet; yet after the part is in place the wire can be easily withdrawn.



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High-lift truck, used by casket company to handle heavy dies, has platform that can be raised to 106 inches, also telescoping uprights which "shrink" to 88 inches, allowing passage through doorways.

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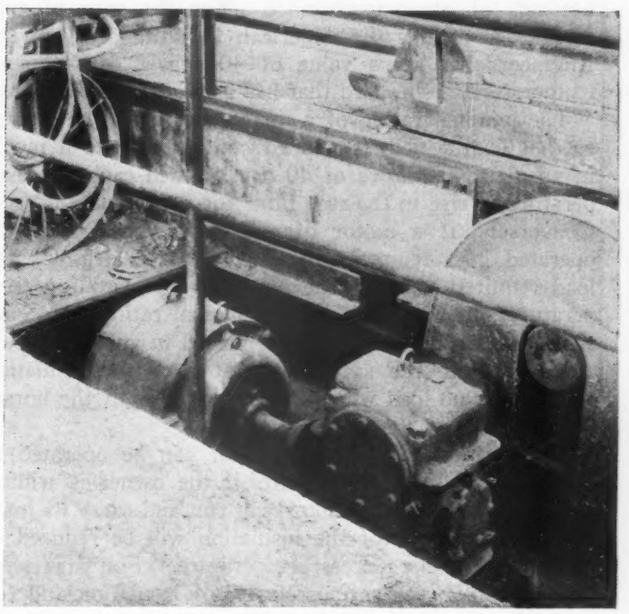


To Keep Motors Going Keep Dirt Out

Francis A. Westbrook, Benson, Vt.

Driving a pouring conveyor in a foundry is a hot, dirty job for any motor. With an open-type machine in such an application maintenance costs are likely to be unduly high.

This possibility was forestalled at the plant of the Wilmington Casting Company, Wilmington, Ohio, by the use of the totally inclosed, fan-cooled motor shown here. It is rated 3 hp., 860/428 revolutions per minute.

•

Capacity of Motors Varies With Temperature

P. F. Gregg, Hollywood, Ill.

Will a 5-hp. motor always deliver 5 hp.? Many persons think that it will, regardless of operating conditions. The fact is that a motor will deliver its nominal rating continuously and safely only if temperature conditions are as specified by the maker. So it is entirely possible that, under certain conditions of temperature, a motor may deliver continuously and safely no more than 90

per cent of its rating; under other conditions it may deliver 110 per cent.

A motor is no better than its insulation. The safe operating limits for any motor are entirely dependent on its insulation, or rather the ability of that insulation to withstand heat without deterioration. The manufacturer of a motor knows what temperature his insulation will safely withstand. In effect, he loads the motor until it reaches this limiting temperature, and the value of the load is the rating of the motor. This rating is not quite definite because nothing has been said about the temperature of the air surrounding the motor. Since the temperature rise varies with the load, this factor becomes of great importance. For the sake of uniformity in ratings the American Institute of Electrical Engineers has set a value of 40 deg. C. for the air temperature, a standard that has been generally adopted.

The nominal rating of a motor may, then, be defined as that load which, if applied continuously to a motor in an air temperature of 40 deg. C. will cause its temperature to rise to the safe limit for the insulation used. Conversely, if a motor of a given nominal rating is operated in a temperature other than 40 deg. C., the load required to bring the motor to its operating temperature will be other than its nominal rating. To consider an extreme case, a motor placed in an air temperature equal to the safe temperature of the insulation could carry no load whatsoever, regardless of the horsepower rating on the nameplate.

Within certain limits any motor can be operated in excess of its safe temperature, if the owner is willing to pay the price. The motor will run and carry its load, but the useful life of the insulation will be reduced in proportion to the excess temperature. For safe temperature limits for various classes of insulation and for methods of temperature measurements the reader is referred to the Standardization Rules of the American Institute of Electrical Engineers.

In designing a motor installation, care should be exercised to allow for free circulation of air about the motor. Motors have been installed within the body of a machine with no provision for air circulation. As a result the air about the motor was considerably above 40 deg. C., with a consequent reduction in the safe load. If it is impossible or inexpedient to avoid such conditions, or if the air temperature is high due to other causes, the motor manufacturer should be consulted. Sometimes a motor of larger size may be recommended; at others, special asbestos insulation may be used.

The hand is not an infallible guide to safe motor temperatures. Few people can hold their hands on a motor that is operating at its safe temperature limit. When in doubt, use a thermometer.

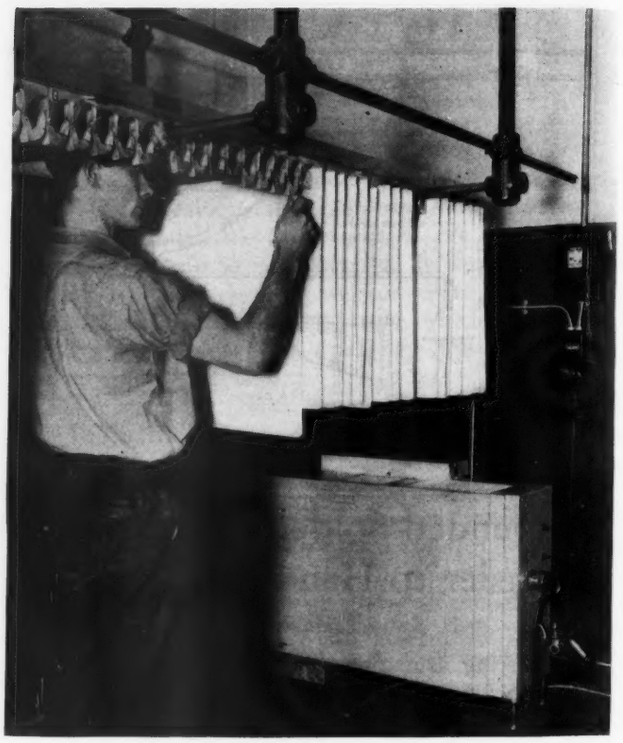
•

No "Paper Troubles" Here

SOURCE, General Electric Co., Schenectady, N. Y.

The part played by modern equipment in taking much of the "grief" out of production processes finds simple illustration in the recent experience of the Maqua Company, Schnectady printers.

In converting a portion of its facilities to offset printing, this concern ran into the "paper troubles" that con-



stantly attend that process, overcame them by keeping its paper stock in a small room where all parts of a sheet, and all sheets in a job, can be brought to the same temperature and relative humidity. The temperature of this room is kept the same as the pressroom. An air conditioner, humidifies, filters, and circulates the air. Two humidistats control the conditioning. One shuts off the unit when the optimum humidity is attained; one starts the conditioner when the minimum desired humidity is reached.

The paper is suspended on racks, as shown in the photograph. Some movement of the moist air is afforded by the conditioner itself. Electric fans on the floor increase the circulation.

The result is perfectly conditioned paper, without which printing of uniform quality is to some little extent a matter of chance.

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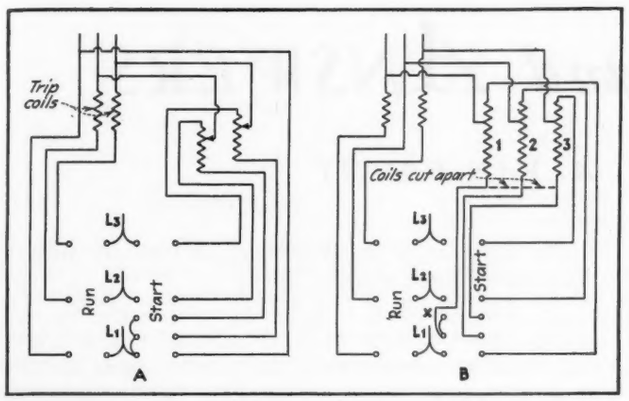
Two-Coil Auto-Starter Adapted for Three Coils

WM. B. CONE, Chief Electrician
Shevlin-Hixon Company, Bend, Ore.

Recently the auto-transformers in an old-style, 100-hp., three-phase, 440-volt, 60-cycle starter burned out. This starter had only two coils and was the only one of that type in the plant.

We had in stock, however, three auto-transformers for another make of starter, of the same rating. These coils were connected for Y operation, as shown in *A* of the diagram, whereas those in the burned-out starter were connected open-delta. In order to restore service as quickly as possible a terminal stud with a short copper ribbon, *X*, was put in, the Y-connected coils were



cut apart, and the other connections changed as diagram *B* shows.

It was a simple matter to bolt the spare coils to a bracket and put them in the case.

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A varnish manufacturer used to run his steam boiler just to heat a 40-gal. kettle. An electric unit saved enough the first year to pay for itself.

•

Cuts Cleaning Costs In Two

SOURCE, Harvey Hubbell Company, Bridgeport, Conn.

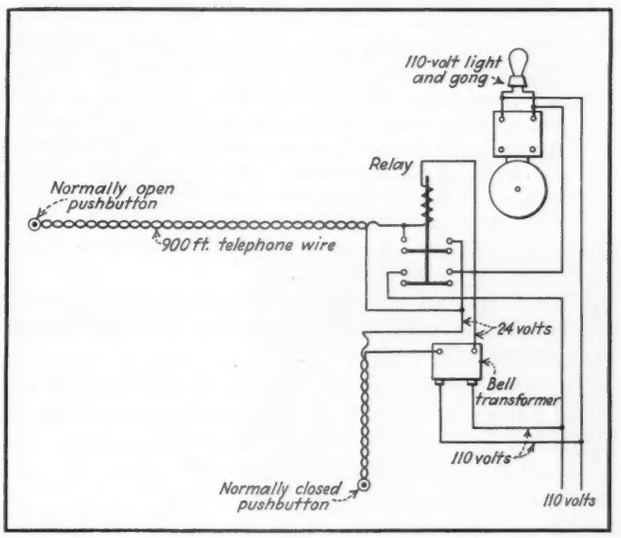
To remove grease and oil from finished screw-machine parts, this company gives them a soda bath, then tumbles them in sawdust in the barrels shown at the left. So far so good. But how to remove the sawdust?

The old way was to shake the parts in a sieve. Effective enough, but backbreaking. Hence the mechanical method recently devised. Trays bearing the parts are now routed from the tumbling barrels via gravity roller conveyor to the mechanical vibrator shown in the center. Finished parts fall below; an exhaust duct carries off the sawdust to the barrels in the right-hand photograph.

Net results include savings in time and energy which cut cleaning costs in half.

Operating 110-volt Signal From 24-volt Circuit—*Correction*

An error was made in the diagram which accompanied the article bearing the above title, on page 509 of the December, 1933, issue. The connection diagram should be as shown here.



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By This Method Quickly Find Shim Thickness

W. L. COTTON, Dalhart, Texas

If a piece of fuse wire or other soft lead is placed between the bearing halves and the bolts drawn up snug, the lead will be squeezed to the thickness of the clearance between the halves. By using caliper or micrometer to measure the thickness of the lead, and allowing for running clearance, the required thickness of shims may be found.

QUESTIONS and ANSWERS

Conducted by G. A. VAN BRUNT

What Instruments for Motor Testing?

We want to check up the efficiency and power factor of our motors, which range from 1 to 100 hp. They are three-phase, 60-cycle machines, operating at 220 volts. Since there is a large number of them, I should like to know the quickest and simplest way of making the tests. What instruments will be required? Also, please explain the difference between the "efficiency" of a motor and its power factor.

B.M.—Baltimore, Md.

GRAPHIC instruments which give permanent records minimize calculations and error, are portable, and decrease testing time.

For testing three-phase, 60-cycle motors ranging from 1 to 100 hp. at 220 volts, the following instruments will give any information desired, except efficiencies:

One a.c. voltmeter reading 0 to 300 volts.

One a.c. ammeter reading 0 to 5 amp.

One power factor meter reading lag 30 to 100 to 70 lead.

Two current transformers, 10 to 800 amp. Split-core transformers facilitate connecting.

The efficiency of a motor is the useful output divided by the total input, expressed in similar units, either watts or horsepower.

The input of a motor is easy to measure with the instruments listed above. Then,

$$Hp. = (E \times I \times 1.732 \times P.f.) \div 746$$

The output of a motor can be measured in two ways: (1) By actual measurement at the motor shaft by means of a prony brake or dynamometer. (2) By calculating all the losses in the motor.

Testing motor output in industrial plants is a difficult problem, since equipment usually is not available for such tests. The better procedure is to secure efficiency curves for each motor from the manufacturer.

The instruments mentioned above should be mounted on a light truck. The connections will be the same for each motor test. The only change necessary will be the current transformer ratio setting.

JOSEPH A. SCHNEIDER, *Steubenville, Ohio*

TESTS should be made from time to time to check efficiency in the use of power, but I doubt the advisability of making both load and efficiency tests on motors, where a large number are concerned. Efficiency can be found by test, but it cannot be improved much if the motor is in good condition. If the motor is not in good condition, a load test will disclose that fact. It will also reveal how much load is on the motor, its

(Continued on advertising page 32)

ANSWERS WANTED

How Stop Sparking of Motor-Generator Sets?

We have three motor-generator sets, each consisting of a 4,400-kw. synchronous motor driving two 1,725-kw., 575-volt d.c. generators. These generators have always given trouble from excessive sparking at the commutators. The commutators have been ground and undercut, but nothing that we have done seems to make much improvement. These machines operate continuously, but are taken out of service once a month for such maintenance as is needed. I shall appreciate it if readers who have had similar trouble will tell me what to do.

A.P.—Flin Flon, Man., Canada

Cracking of Storage Battery Plates

Storage batteries of the lead-acid type used in our fire alarm system are givng trouble through cracking and breaking of the plates. These batteries, which have been in service for three years, have had good care. Can readers tell me the cause of this trouble? Is it possible to repair cracked or broken plates?

A.C.P.—Quebec, Canada

Better Control of Lubrication

Some investigation of our methods of handling lubrication indicates room for improvement. Our equipment ranges from fairly heavy rolling mills and punchpresses to light machines operating at high speed. At least fifteen kinds or grades of oil are used. with about as many grades of grease. Each department keeps its own supply of lubricants, and operators are responsible for lubricating production machines. The maintenance department handles lubrication of all motors, of which there are about 400. We have a considerable amount of bearing trouble, which I believe could be lessened by better control. Use of fewer grades of oil and grease would also be desirable, if it is feasible. I wish that readers would suggest how we can handle lubrication to better advantage. How should we go about reducing the number of grades of lubricants used? J.M.S.—Cleveland

· EQUIPMENT NEWS ·

Locomotive

Industrial with "Caterpillar" diesel engine. Chassis similar to those on Brookville gasoline-powered locomotives. Four-speed sliding-gear transmission and all-speed reverse. Dual-spring suspension for cushioning load. Oversize roller-chain drive to four wheels. Timken tapered roller bearings on lower axles. Model D-6110, 3-cylinder engine develops 37 brake hp. at 850 r.p.m. with peak of 47 hp. for intermittent loads. Maximum speed 15 miles per hour. Sizes 6, 8, 10, and 12 tons. Brookville Locomotive Co., Brookville, Pa.

Truck

Tilting telescopic fork, Type "T.T.T." Model A (S) 1002-1. Lifting and tilting accomplished hydraulically. Load lowered by gravity. Truck carrying capacity 3,000 lb. for 36-in. platen. Fork spacing adjustable. Telescopic lift allows piling of uniform pallet loads to height of 18 ft. Truck capable of right-angle piling from 114-in. aisle. Capacities from 2,500 lb. to 4,000 lb. Mercury Manufacturing Co., 4118 S. Halsted St., Chicago.

Time Recording and Analyzing Instruments

Three Kienzle instruments: "Time-loss" indicator for indicating net operating hours of machines and equipment. Operates mechanically or electrically. Records on visible dial entire net operating time of machine during working periods, independent of speed. Difference between working period and net operating hours yields lost time of machine. Incorporated counter continuously adds up net operating hours.

"Checkograph," for automatic recording of operations or processes according to number of pieces, footage, speed characteristics, time consumption, delays. Eight-day registration. Connected with flexible shaft, stroke mechanism, or operated electrically.

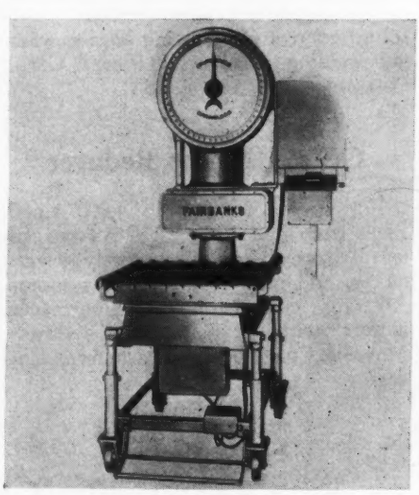
"Time Analyst" — hand-operated mechanical device for recording detail and time in graphic form, for time and operation studies. M. Klein & Co., Inc., Instrument Division, 220 Fifth Ave., New York.

Geared Motor Reducer

Planigressive Multi-Speed. Designed to give both reduction and variation in speed. Reduction obtained through composition planetary gears. Speed can be changed while reducer is running with or without load, or with reducer stopped. Reducer can be run in either direction. Sizes from ¾ hp. to 10 hp. Listed according to frame of motor. Combinations of ratios from 3:1 to 7:1. Reductions up to 600:1. Davis & Thompson Co., 6619 W. Mitchell St., Milwaukee.

Scale

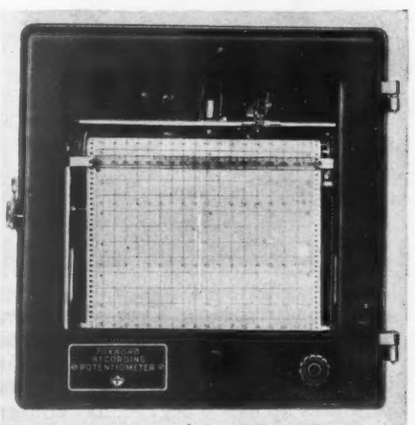
Combining dial face, mechanical recorder, and roller-conveyor platform. Load located by means of raised roller on scale platform, weighed by depressing treadle. Automatically printed weight figures. Weight recorders are adaptable to varied layout, may be applied to Fairbanks dial scales for all weighing purposes. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.



Motor

Arbor. Open-type ball-bearing squirrel-cage, rated 2 hp., 3,500 r.p.m., 60 cycles. End shields provided with feet. Stator assembled in sheet-metal housing. The Louis Allis Co., Milwaukee.

Pyrometer



Recording potentiometer, with balancing device, designed to produce large movement of pen or print wheel for small galvanometer deflection and move printing mechanism from one end of scale to other in short time. Mechanism consists of V-shaped drive cam and friction roller. Recorder housed in fume-tight, dust-proof case. Designed for either flush or surface mounting. The Foxboro Co., Foxboro, Mass.

Connector and Coupling

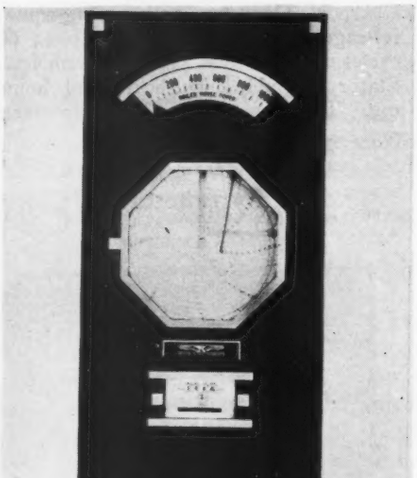
Cushion connector, comprises two studs in line but set apart and vulcanized into block of rubber for mounting motors. Flexible rubber coupling designed to smooth out sudden jerks when starting motor and correct slight misalignment between motor shaft and driven unit. Consists of short rubber cylinder, each end of which is bonded over hollow metal insert. Made in various sizes for all types of motor-driven equipment. Firestone Tire & Rubber Co., Akron, Ohio.

Test Set

Portable, combustion. In steel case. Combines Hays CO_2 Analyzer and Hays Dry Type Pointer Gage. Small foun-

tain-pen-type flue-gas thermometer can also be supplied. Weight, 9 lb. Reels and clamps for rubber tubing and accessories. Carrying handle swings out of way when unsnapped. The Hays Corp., Michigan City, Ind.

Thermometers



Dial and recording. Type 57 is vapor-tension, self-contained or distant-reading, dial type, with 5-in. dial. Type 58, gas-filled, self-contained, dial-type, for temperatures up to 800 deg. F. Has uniform dial scale. Type 59 is round-form, recording-type for general industrial application. Two general types—gas-filled for temperatures up to 1,000 deg. F., vapor-tension for steam and hot water applications where operating range does not exceed 30 per cent of scale range. Jas. P. Marsh Corp., 2073 Southport Ave., Chicago.

Oil Control

Alvor Constant Level. Designed to maintain automatically constant oil level in ring-oiled bearings or anti-friction bearings suitable for oil-bath lubrication. Feeds only enough oil to maintain required level. Operates on liquid-seal principle. Feeds only when oil level in bearings drops below end of shank, breaking liquid seal and permitting air to enter bottle. Refilling accomplished by lifting bottle with its base out of fitting, without disturbing any connection. The Lunkenheimer Co., Cincinnati.

Bearing

Flanged, precision, spindle, ball. Shoulders on bearing. Bearings separable to facilitate assembly. Sizes from 30- to 130-mm. bore, to precision specifications, two bore sizes for each standard outside diameter. New Departure Mfg. Co., Bristol, Conn.

Switch

No-Arc, mercury tube. Single, double, triple, and quadruple poles, each pole consisting of mercury tube switch with ratings of 30 amp., 125 volts, 20 amp., 250 volts, a.c. or d.c., for inductive or non-inductive loads. Operating coils can be furnished for standard voltages up to 250 volts d.c. or 440 volts a.c. Also for 6 volts d.c., 24 volts a.c. Mounted on non-combustible bases and in water-proof boxes. For lighting circuits, solenoids, motor operation, and for locations where there is flammable gas or dust. Hart Mfg. Co., Hartford, Conn.

Motor

Long-shafted, fractional-horsepower, for operating multiple fan units in air-conditioning apparatus. Variable-speed, single-phase, a.c., capacitor type. All-metal resilient base, wool-packed bearings, motor and control apparatus self-contained. The Holtzer-Cabot Electric Co., Boston, Mass.

Welder

Universal, portable. Shunt-inductor principle of arc stabilization. Motor-generator and gasoline-engine-driven models. Four-wheel trailer mounting.

Idling control for slowing engine when not welding. Universal Power Corp., Clarkstone Rd., Cleveland.

Geared Motor Reducer

For speeds from 2 to 4,000 r.p.m. Sizes from ¾ to 75 hp. Three types, integral gear motor, all-motor-type gear motor, and gear-head-type gear motor. All are combinations of horizontal motors with gear units. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.

Flow Meters

Republic. Redesigned with cartridge-sealed elements. Elements consist of actuating unit built to fit into metal cartridge for mounting on instrument panel. Three types of reading instruments (indicator, recorder, and integrator), each with its actuating mechanism mounted in separate elements, are interchangeable and may be removed from back of panel. Republic Flow Meters Co., Chicago.

Scale

Toledo Printweigh, Figured Type. Automatically and mechanically selects and prints correct weight figures. Prints inserted ticket, continuous strip, or both. Control may be located on scale, at remote point, or placed to operate automatically in connection with conveyor system. Printing device can be furnished on Toledo Dial Scales of from 62½- to 10,000-lb. capacity. Can be attached to any late-model dial scales of similar capacity. Toledo Scale Co., Toledo, Ohio.

Rust Preventer

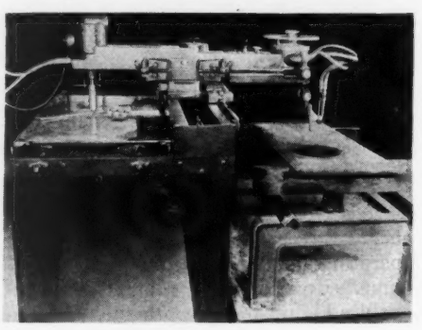
Called "Rustproofer." In liquid form. Can be brushed or sprayed over new or rusted metal surfaces. Claimed to form non-porous, moisture-proof, air-tight coating that renders surface immune to further rust deposit. Aluminum powder, powdered graphite, or dry red lead may be mixed with "Rustproofer" to provide decorative finish. Liquid itself is transparent and will not hide markings or identification signs on metal. Stonhard Co., 401 N. Broad St., Philadelphia.

Motor

Splash-proof. Solid cast frames and end bells. Fan-shaped air duct with removable perforated baffles. Water-deflector ring around shaft is removable if pulley or coupling is installed next to bearing housing. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.

Cutting Machine

Called "Pantosec." Precision shape-cutting machine, suitable for cutting dies, cams, and parts. Cutting range 44 in. longitudinally, 20 in. laterally, straight-line, angle, bevel, circle. Re-



quired floor space 72x83 in. Consists of carriage mounted on three-point supports. Gas pipes inclosed in carriage, drives cased. Motor to run on 110 or 220 volts. Linde Air Products Co., 30 E. 42d St., New York.

Switch

Transfer, selector. Rated 4,000 amp., 7.5 kv. Single-pole, double-throw, front- and back-connected, with 90-deg. blade stop and blade locks. Non-magnetic supporting base provided with U-bolts for pipe mounting. Terminals arranged for direct bolt connection to copper buses. Delta-Star Electric Co., Chicago.

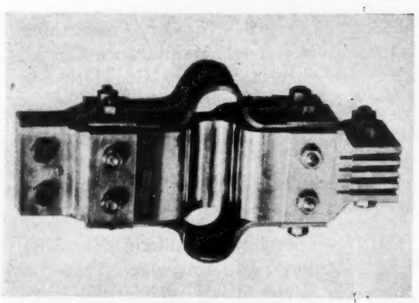
Motors

Single-phase, capacitor. Similar in construction to two-phase squirrel-cage motor with condenser connected across one phase for starting. Condenser automatically cut out of circuit by contactor when motor comes up to speed. Marble-Card Electric Co., Gladstone, Mich.

Iron

"Super Manga." Nickel-chromium cast iron. Claimed to be highly abrasion-resisting. Structure: Martensitic with refined carbide network. Composition: Base mixture with about 4.5 per cent nickel and 1.5 per cent chromium added. Chilled surface has Brinell hardness of 600-750. May be sand cast. When fully hardened, is not machinable. Robins Conveying Belt Co., 15 Park Row, New York.

Bus Expansion Joint



Designed for connecting 4x¼x4-in. vertical bars to 4x¼x4-in. horizontal bars. Rated 4,000 amp. Will connect bars in same plane or in planes at right angles to each other. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

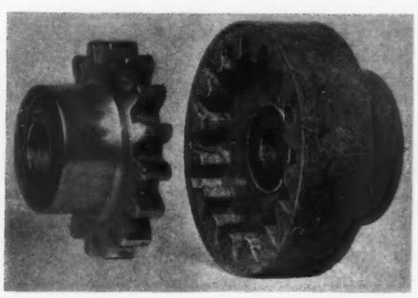
Painting Machine

"Norris Electrical Airless." Self-contained. Utilizes centrifugal force to apply paint or other material. Delivers fan-shaped spray controllable from 1 to 18 in. wide with sharp cut-off on all four sides at option of operator. Quantity control by valve at base of machine permits one- or two-coat finish. Claimed not to cause paint fog or dirt. Held in hand when in use. Plugs into 110-volt circuit. Weighs 5½ lb. Electrical Painting Equipment Co., Inc., 247 Park Ave., New York.

Protective Skin Creams

For preventing skin infection originating in cooling lubricants, plating compounds, oil emulsions, broaching compounds, etc. Applied before work. Ply No. 1, only soluble in water, for preventing staining materials from clinging to skin. Ply No. 2, same as No. 1, with addition of ichthyol base for preventing and localizing skin infections. Emulsifies in water. Ply No. 3, not soluble in water, leaves skin slightly oily when applied, contains counter-irritant in addition to protective qualities. Milburn Co., Free Press Building, Detroit.

Coupling



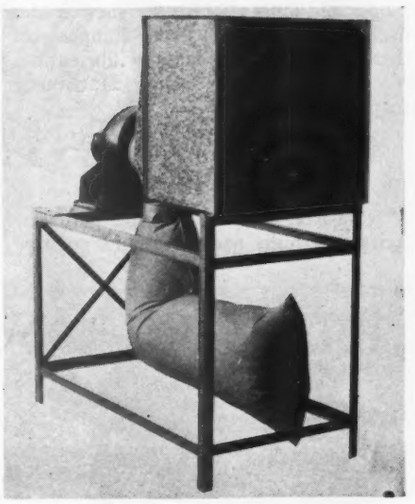
"Celoron," sprocket. Female end molded of macerated Celoron (synthetic material not affected by heat or cold, oil, water, or gasoline, and having tensile strength of 10,000 lb. per sq.in.) Male end consists of metal sprocket. Seven standard types for drives from ½-4 hp. at 100-6,500 r.p.m. to 20-85 hp. at 100-2,500 r.p.m. Continental-Diamond Fibre Co., Bridgeport, Montgomery County, Pa.

Chairs

Metal, folding. For auxiliary seating in industrial plants and mills. Several models. Also factory stool with seat height of 26 in., diameter of 12½ in., and 13-in. spring back. The Stewart Iron Works Co., Cincinnati.

Electrode

For welding cast iron by shielded-arc process. Known as "Ferroweld." Steel core surrounded by heavy flux coating. Used with 80-amp. current. Only one size—⅛ in. Lincoln Electric Co., Cleveland.



Spray Gun and Booth

For flock. Gun, Type GB, has cast aluminum body, pistol-grip handle, thumb-button air control, three adjusting valves for controlling main-line air pressure, type of spray, and air entering agitator. Booth, Type XF, is galvanized sheet steel with smooth interior and funnel-shaped back leading to blower unit. Two or three feet wide, 3 ft. deep, 5 ft. high. Provision for reclaiming excess material. The DeVilbiss Co., Toledo, Ohio.

Test Set

Dielectric strength. Model 1-IE. For testing insulating value of sheet materials used in electrical equipment; also complete units. In metal case 16x18½x8¼ in. Weighs 65 lb. Operates on 110-volt, 60-cycle supply. Available for 220 volts. Secondary delivers 10,000 volts maximum. Meter calibrated in three ranges; 0-1,000 volts, 0-5,000 volts, and 0-10,000 volts. Sound Engineering Corp., 416 Leavitt St., Chicago.

Valve

Fluid cut-off. For use with DeVilbiss spray guns. Permits operator to drain gun of fluid, blow out any obstruction in fluid tip without disconnecting gun from hose. Type H-5135. The DeVilbiss Co., Toledo, Ohio.

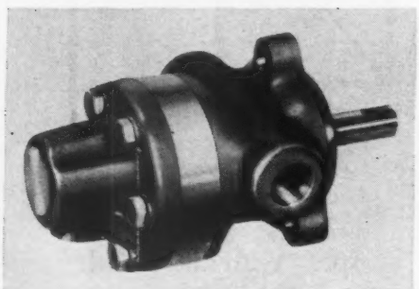
Compressors

"Unibloc" diesel and gas-engine, refrigeration. Compressor cylinder mounted directly on base of standard Worthington vertical four-cycle diesel or gas engine. Piston of one power cylinder is replaced by cross head, connected by piston rod to compressor cylinder directly above. Suction valve

is operated automatically by suction and discharge pressures of compressor. Mechanical force-feed lubrication. Worthington Pump and Machinery Corp., Harrison, N. J.

Pump

"Rota-Roll" hydraulic. Small capacity for high pressures and positive



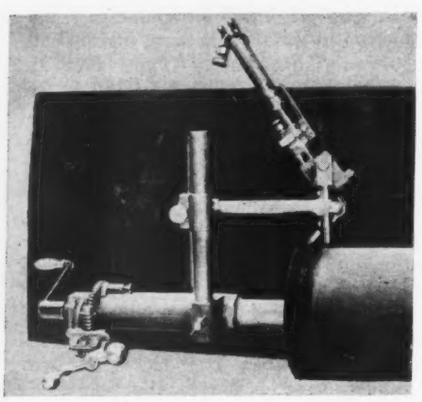
displacement. Operates at motor speeds. For water, oil, and other fluids. Consists of rotor and roller which revolve together. All revolving parts mounted in roller or needle bearings. Two sizes, capacities of one and two gal. per min. at 1,725 r.p.m. Sundstrand Machine Tool Co., Rockford, Ill.

Geared Motor Reducers

Four additions to line. All-Motor Type "Z," similar to All-Motor Type "U," but with motor-supporting ledge in form of separate adapter fixed to housing. Single-reduction Type "LU" combines features of geared-head and all-motor types. 2-Speed Motoreducer (non-shiftable under load) has both speed range and speed reduction in single housing. Vertical Motoreducer, Types "DUX" and "RUX," claimed to solve problem of oil leakage. The Falk Corp., Milwaukee, Wis.

Pipe Cutting Machine

Oxyacetylene. For straight or bevel cuts. Consists of center rod with three spreading arms which press against



inner wall of pipe, holding it in position; arm supporting blowpipe can be adjusted to desired angle. Blowpipe and arm rotate without use of crank for quick centering of device. Will take most hand-cutting blowpipes. Portable. The Linde Air Products Co., 30 E. 42d St., New York.

Locomotives

Plymouth, 8- and 12-ton. Caterpillar diesel engines. Eight-ton model has 4-cylinder engine which develops 66 hp. at 850 r.p.m. Twelve-ton has 6-cylinder engine developing 102 hp. at 820 r.p.m. One-piece steel-plate frame with welded joints. Dry-plate clutch. Four speeds forward and four reverse. Semi-elliptic, cross-equalized spring suspension. The Fate-Root-Heath Co., Plymouth Locomotive Works, Plymouth, Ohio.

Metal Degreasing

E. I. duPont de Nemours & Co., Inc., Wilmington, Del., announces purchase of metal degreasing business of Carrier Metal Cleaning Division of Carrier Engineering Corp., Newark, N. J. Products involved are Carrier vapor degreaser machine and Cecolene, a solvent used in connection with the machine.

Arc Extinguisher

For use in connection with single-break type of contactor to speed a.c. arc extinction. Mounts on base of contactor or linestarter. Unit consists of small capacitor and resistor connected across poles on load side of contacting device. Called "Arc Arrester." Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.

TRADE LITERATURE

ALUMINUM—Booklet, "Alcoa Aluminum for Truck Bodies," including supplementary drawings.—Aluminum Co. of America, Pittsburgh, Pa.

BAKELITE — Booklet, "Synthane Laminated Bakelite—Silent Stabilized Gear Material," including properties and machining instructions.—Synthane Corp., Oaks, Pa.

BEARINGS—Bulletin G-1, "Marine-Type and Heavy Industrial Mountings—Kingsbury Thrust Bearings and Journal Bearings."—Kingsbury Machine Works, Inc., 4324 Tackawanna St., Philadelphia, Pa.

BRONZE CASTINGS—Booklet, 16 pages "Elesco Bronze Castings."—The Superheater Co., Bronze Foundry Division, East Chicago, Ind.

BUSHINGS — Bulletin EM-4, "Johnson Phosphor Bronze Electric Motor Service Bushings." — Johnson Bronze Co., New Castle, Pa.

CAPACITORS—Bulletin 710, "Ideal Capacitors for Power Factor Correction."—The Ideal Electric and Mfg. Co., Mansfield, Ohio.

CHEMICAL EQUIPMENT — Booklet, 29 pages, "Haveg Corrosion Resistant Chemical Equipment."—Haveg Corp., Newark, Del.

COUPLINGS—Catalog, describes flexible shaft-couplings, including Type "RC" employing Link-Belt Silverlink Roller Chain —Link-Belt Co., 910 S. Michigan Ave., Chicago.

ELECTRICAL MACHINERY — Catalog, 24 pages, "Marble-Card Super-Service Electrical Machinery."—Marble-Card Electric Co., Gladstone, Mich.

ELECTRIC FURNACE—Booklet, "Electric Melting with the Detroit Rocking Electric Furnace."—Detroit Electric Furnace Co., Detroit.

ELECTRIC HEATING UNITS—Leaflet TB 30, Page 9, "Trent Electric Heating Cartridge Units Effectively Heat That Spot." —Harold E. Trent Co., 618-640 N. 54th St., Philadelphia, Pa.

GEARED MOTOR REDUCERS—Bulletin No. 270, "Falk Motoreducers." — The Falk Corp., Milwaukee, Wis.

INSTRUMENTS—Bulletin No. 185, "Pressure Instruments for Recording, Controlling, Indicating."—The Foxboro Co., Foxboro, Mass.

LADDER MOUNT — Folder, "Something New to Lower Your Maintenance Costs." —Electric Service Supplies Co., 17th and Cambria Streets, Philadelphia, Pa.

LUBRICATION—Engineering Bulletin D-103, "Diesel Engines and Their Lubrication."—Technical Division, Standard Oil Co. (Indiana), Chicago.

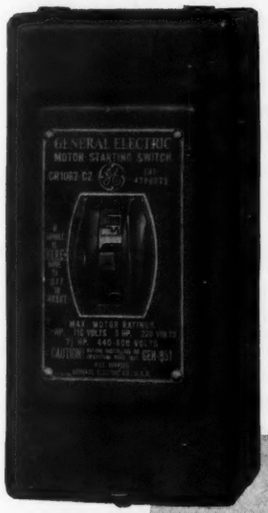
PAINT — Technical Bulletin No. 3304, "Final Report of Ambridge Tests of Paints for Water Tank Interiors."—Pittsburgh-Des Moines Steel Co., Neville Island, P. O., Pittsburgh, Pa.

PIPE—Bulletin, "Diescherized Pipe and Tubing."—The Babcock & Wilcox Tube Co., Beaver Falls, Pa.

PIPE—Form ADV. 220-B, "Toncan Iron Pipe for Permanence."—Republic Steel Corp., Youngstown, Ohio.

PUMPS — Bulletin 260-B11, describes Type 'T' turbine pumps.—Roots-Connersville-Wilbraham, Connersville, Ind.

(Continued on advertising page 42)



No. 1. CR1062-C motor starter

WHICH STARTER *for Your Small A-C Motors* ?

HERE ARE THREE GOOD ANSWERS

No. 2. CR1062-B motor starter

No. 3. CR1062-E3B explosion-proof motor starter

1. For your motors up to 7 1/2-horsepower, use the CR1062-C switches. Both wall- and pedestal-mounted models are available.

2. For your small motors rated at 2 horsepower or less, use the CR1062-B switches. Wall and pedestal mountings are available.

3. If you are confronted with Class I, Group D, explosion hazards, use the CR1062-E3B switches. Ratings in this line are available from 1/2- to 7 1/2-horsepower.

These lines of manually operated starting-switches include models for single- and three-phase operation, and all standard voltages under 600 volts.

FEATURES

Thermal-overload protection — trips free on overload—easily reset

Positive action — silver contacts reduce arc-burning

Molded, arc-resisting base—switch completely enclosed

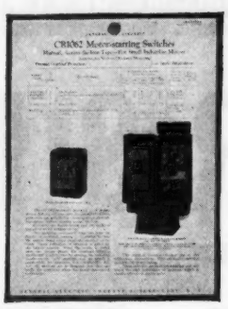
Easy to install — base easily removed — plenty of space for wiring

Inexpensive

In addition, General Electric makes a complete line of magnetic switches for use where push-button starting is desired.

NRA MEMBER U.S. WE DO OUR PART

GENERAL ELECTRIC



SEND FOR COMPLETE INFORMATION

General Electric Company, Department 6C-201,
Schenectady, N. Y.

( ) Please send me descriptive booklet on CR1062 starting switches (GEA-1522A.)

( ) Please send me descriptive sheet on CR1062-E3B explosion-proof switches (GEA-1744.)

NAME .....

COMPANY .....

ADDRESS .....

080-1

(Continued from editorial page 42)

power factor and, if an extended test is made, whether the load is steady or varying.

There are two methods of making efficiency tests, the running light test and the prony brake method. Both of them require considerably more equipment and calculation than does the load test.

Were I making the load test, I would want one polyphase, or two single-phase, wattmeters, a voltmeter and two ammeters. For the larger motors current transformers probably will be necessary for the wattmeter and the ammeters. A feeler gage for determining the air gap width around the rotor will be useful, too, because when motor bearings wear and allow the air gap to become unequal the motor efficiency drops. The two ammeters are used to reveal unbalanced phase loads.

The power factor is found by dividing the wattmeter reading, in watts, by the product of the voltage, times current, times 1.732, and multiplying the quotient by 100. The result is the power factor in per cent.

It is in the loading and drive connection that the real savings are to be made, and not in the efficiency of the motor itself. However, to get the best out of a motor keep the phase loads balanced, or nearly so. Shorted turns in a coil or dirty connections cause unbalanced phase loads. Keep the air gaps equal by frequent examination of the bearings, and run the motor at as nearly full load as possible. In this way maximum efficiency and power factor are obtained.

ROY M. STINSON, *Operating Engineer*
Rock Island Lines, Chicago

Locating Grounded Coils in Motor

When an insulation resistance test shows a ground to the frame on one phase of a three-phase motor, what is the best or quickest method of locating the defective coil? How can a short between phases best be located? *P.J.—Chicago, Ill.*

GROUNDED coils in motor windings usually may be quickly located by "smoking out," using 110-volt current with resistance in the line to prevent blowing fuses. A suitable rheostat will be needed. One side of the line is connected to the motor frame and the other side to one of the motor leads, preferably to the lead of the grounded phase, if it is known. The current is turned on gradually, by cutting out resistance, until either an arc or smoking at the grounded point indicates the location of the ground.

Another method in more general use involves testing and eliminating until the defective coil is located. A test light, magneto, or some form of circuit tester is used in this method. The procedure is as follows: First separate the phase windings. If the motor is star-connected, open the star point; if delta-connected, disconnect at the point where the phase windings are connected (where the motor leads are connected).

When the phase windings have been separated, locate the one containing the defective coil. If the other two phases test clear, they may be eliminated. Next, cut a group connector midway of the phase winding, dividing the winding in which the defective coil is located in half.

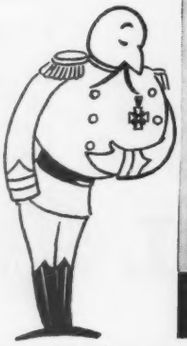
MORSE PRESENTS

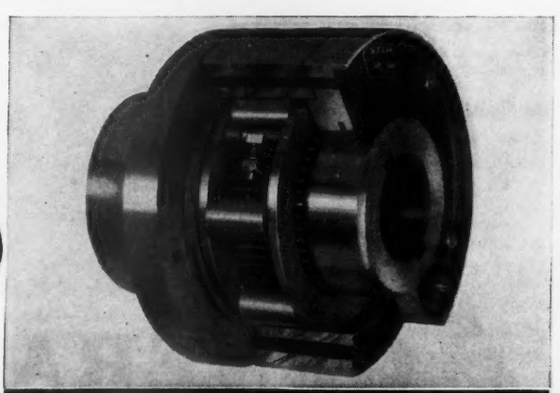
A POSITIVE-ACTION free-wheeling clutch for industrial installations, simple in design and construction. Nickel alloy steels hardened and ground to close limits insure long life and constant service.

Suitable for high speeds, the Kelpo runs cool, is perfectly balanced, and is not affected by centrifugal force. It is the only free-wheeling clutch which compensates for wear.

Kelpo Clutches can be used wherever wheels turn—many special machine applications. Interlocking between two power sources is unnecessary when the Kelpo Clutch is used.

Kelpo Clutches are now manufactured by the Morse Chain Co.—your assurance of quality and proper engineering application. Write for more information.





MORSE-KELPO FREE WHEELING CLUTCH

MORSE

ITHACA, NEW YORK

Manufacturers of Morse Silent Chains · Roller Chains · Standard Couplings · Flexible Couplings · Pullmore Clutches

Again test to locate the part of the winding in which the ground is located. Continue until the coil group in which the ground is located has been found. Disconnect and test individual coils in a similar manner.

Shorts between phases may be located in a similar manner, either by "smoking out" or testing. If the first method is used, connect the two sides of the testing line to the terminals of the two phases that are shorted, first disconnecting the windings from each other.

W. L. COTTON, *Electrician*
Rock Island Lines, Delhart, Texas

Laying Out Short-Center Drive

We will install an air compressor driven by a 200-hp., 580-r.p.m. motor through a short-center drive with idler pulley. The motor pulley is 28 in. in diameter, compressor pulley 84 in., and idler 19 in. All have 20-in. faces. I should like to know (1) What should be the distance between centers of the compressor and motor pulleys? (2) Is it necessary to have the centers of the motor and compressor pulleys on the same level? (3) Should the normal level of the idler pulley be above or below the level of the motor pulley? (4) What should be the center distance between the idler and motor pulleys?

R.C.—High Shoals, N. C.

CENTER distance between compressor and motor pulleys should be kept above 84 inches.

It is desirable to keep the motor and compressor pulley centers on the same level, or close to it.

The normal level of the idler pulley should be as nearly as possible the same as that of the motor pulley.

The idler pulley should be set as close to the motor pulley as it can be without actually interfering.

The ideal arrangement would be to have the centers of all three pulleys on the same level, and with the idler pulley set close enough to the motor pulley to obtain 270 deg. arc of contact on the motor pulley. No more weight or spring tension should be used on the idler pulley than is needed to prevent more than 2 per cent slip or creep of the belt. A paper, compressed cork, or wood pulley for the motor is highly desirable.

R. P. GUILDFORD, *General Engineer*
Westinghouse Electric & Mfg. Company
Philadelphia, Pa.

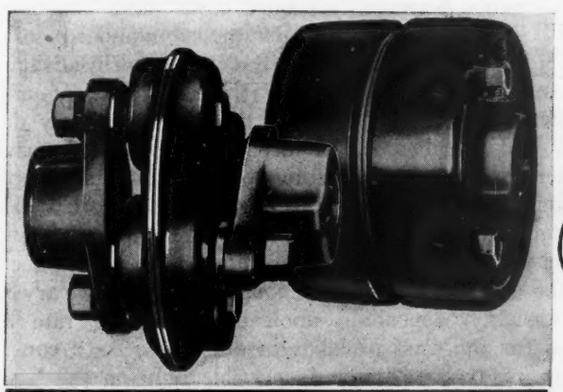
WITH AN idler pulley almost any center distance can be used so long as the idler can clear both the motor and the driven pulleys if the belt breaks. Good practice is to allow enough room for the idler pulley so that the distance measured from the point where the belt makes contact on the motor pulley to where it contacts the idler pulley equals the width of the belt. On R. C.'s drive the shortest centers that I would recommend would be 9 ft. If this distance can be increased the life of the belt will be increased.

It is not necessary to have the centers of the motor and compressor pulleys on the same level.

The normal level of the idler pulley should be 4 in. above the center line. That is, its center should be 4 in. above a line connecting the center of the motor pulley

MORSE PRESENTS

A Companion to the Standard Chain Coupling



THE MORFLEX COUPLING

THIS new Morse Flexible Coupling, a fitting companion to the Morse Standard Coupling, is both simple in design and rugged in construction. It is noiseless in operation, and utilizes a new, especially developed rubber as the flexing medium.

Accurate tests of the Morflex Coupling demonstrate a maximum of flexibility without power loss. Shocks and uneven impulses are absorbed, and sudden reversal can take place without damage.

The Morflex Coupling needs no lubrication. It needs no protection from atmospheric conditions—water, oil, dirt or grit do not interfere with its smooth operation.

Made by Morse Chain Co., which means quality and precision products. Write for further information.

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DETROIT, MICHIGAN

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Every LO-HED is a heavy-duty hoist. Capacities up to 24,000 pounds. Wide variety of types.

That Block Goes Up
until it touches the rail

Right up between the drum and the motor goes the block on any Lo-Hed Hoist—only the tip of the hook shows below the casing when load is fully up.

That is why Lo-Hed is the only hoist to use where headroom is limited—why Lo-Hed can stack materials almost to the ceiling—why it can handle 8′ castings in 10′ headroom—can put big packages through doorways or into box cars.

Buy Lo-Hed Hoists—save space, save time and effort, money and men. Rugged, durable, all-steel hoists—¼ ton to 12 tons capacity. Write for bulletins.

AMERICAN ENGINEERING COMPANY
PHILADELPHIA

LO-HED PATENTED

with the center of the compressor pulley. When installing the drive the idler can be lowered by allowing the motor to move forward on the rails until the belt begins to slip at full load. Then measure the distance from the idler to the bottom or tight side of the belt and never allow the idler to fall below this distance.

With a 19-in. idler the distance between the motor and idler pulley centers is 32 in. This is figured in accordance with good practice. I suggest use of a 28-in. idler pulley instead of a 19-in., since it will avoid excessive bending of the belt. The idler should be a gravity type equipped with roller bearings and the arms on which the idler pivots must be well lubricated.

An 18-in. belt will transmit the load; however, it will have to withstand an overload to take care of starting torque. Therefore, I suggest use of the best quality of heavy double leather belting, especially constructed to withstand the side flexing when the belt passes from the crowned face of the motor pulley to the flat face of the idler pulley.

If it is desired to use shorter centers than 9 ft. I recommend the use of a pivoted motor base, which does not require an idler pulley.

C. H. LEIDE
Engineering Department
Chicago Belting Company, Chicago

Standard Costs for Maintenance Operations

Certain operations, such as glazing and cleaning windows, painting, sweeping, scrubbing, and the like are performed periodically in all plants. Do you know whether "standard costs" or "standard times" have been worked out for such operations? If so what are they? *A.K.—Philadelphia, Pa.*

BEFORE attempting to answer these questions the difference between "standard costs" and "standard times" should be clearly understood. Standard costs apply to costs that are accurately determined in advance and, of necessity, presuppose the establishment and maintenance of standard times through a properly devised and installed wage incentive plan which pays workers directly in proportion to their accomplishment.

Standard times for performing identical work under the same conditions and with labor of equal ability, will be the same in Philadelphia, Boston, or San Francisco, but the cost for this given amount of time may vary in each locality, depending upon the prevailing rate of wages for the class of labor in question. As a consequence ready comparison is possible only on the basis of the standard times for work of the same character.

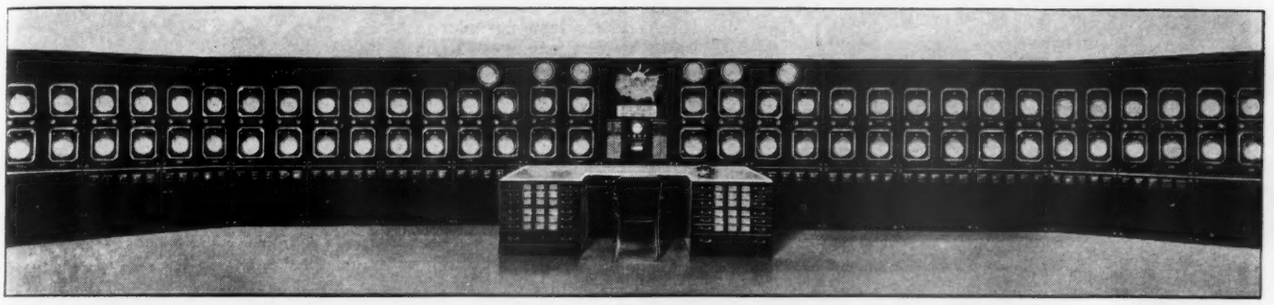
Standard times for painting in plant maintenance work, as used by several concerns, are as follows:

Brush Painting: Prime coat: 15 sq.yd. per man-hour.
2d and 3d coats: 10 sq.yd. per man-hour.
Spray Painting: Prime coat
2d coat 55 sq.yd. per man-hour.

For the performance of such work as sweeping, scrubbing, dusting, etc., in a large city office building the use of standard times increased the number of square feet covered per hour from 623 to 1,028 and cut the cleaning time 39½ per cent. These standard times are as follows:

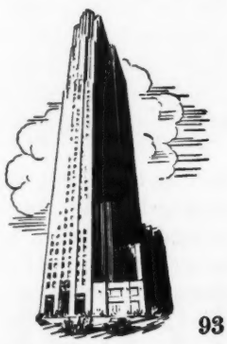
(Continued on page 36)

WHERE 64 SENTINELS OF N.B.C. WEATHER STAND GUARD—Focal point of this giant air conditioning system is a beautiful remote control room on the tenth floor of the R.C.A. Building. This panel of 64 Taylor Recording Regulators provides individual control of temperatures for N.B.C. broadcasting studios and offices.

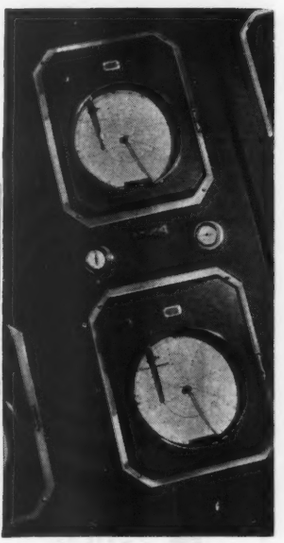


THIS FAMOUS SYSTEM OF TEMPERATURE CONTROL

Designed and Installed at Radio City by Carrier and Taylor Engineers



Provides N.B.C.'s Huge Weather-Making Plant with a Centralized Control That Regulates and Records Air Conditions for Each Separate Studio Within 1° ± ½



HIGHLIGHTS OF THE N.B.C. AIR CONDITIONING PLANT

...The most intricate air conditioning system ever built. Three years in the making. Cost approximately $1,000,000. Handles 23,000,000 cubic feet of scientifically conditioned air per hour. Provides complete air change every 8 minutes for N.B.C. studios and offices in Rockefeller Center's R.C.A. Building, the world's largest office building. Has a refrigerating capacity equal to 20,000 refrigerators.

The Carrier Engineering Corporation is contractor for the air conditioning plant. Working with them, Taylor Instrument Companies provided the temperature control system. Clyde R. Place are the consulting engineers.

In addition to the main control, 29 more Taylor Recording Regulators control and provide a continuous 24-hour record of the atmospheric conditions for all retail shops in the R.C.A. Building. As this close-up shows, they maintain the temperatures required within 1° ± ½.

93 Taylor Recording Regulators, 250 Taylor Industrial Thermometers, 104 Taylor Even-Action Valves, 37 Type-P Air-Operated Thermostats, 6 miles of tubing in individual lengths up to 375 feet. All coordinated by the engineers into a system of remote control so highly sensitive and accurate that it maintains any air condition desired in each of National Broadcasting Studios and retail shops in Rockefeller Center's new R.C.A. Building within 1° ± ½!

"Almost human," is the way A. Warren Canney, of Clyde R. Place, Consulting Engineers for this mammoth air conditioning system, describes it. It affords another example of how Taylor is serving industry today by working with other engineers to meet and solve difficult and exacting temperature control problems.

In every industry this same Taylor service is finding ways to new production economy and efficiency. For Taylor Service goes far beyond the installation and replacement of instruments. It brings to bear an experience of 80 years in meeting industry's temperature control needs.

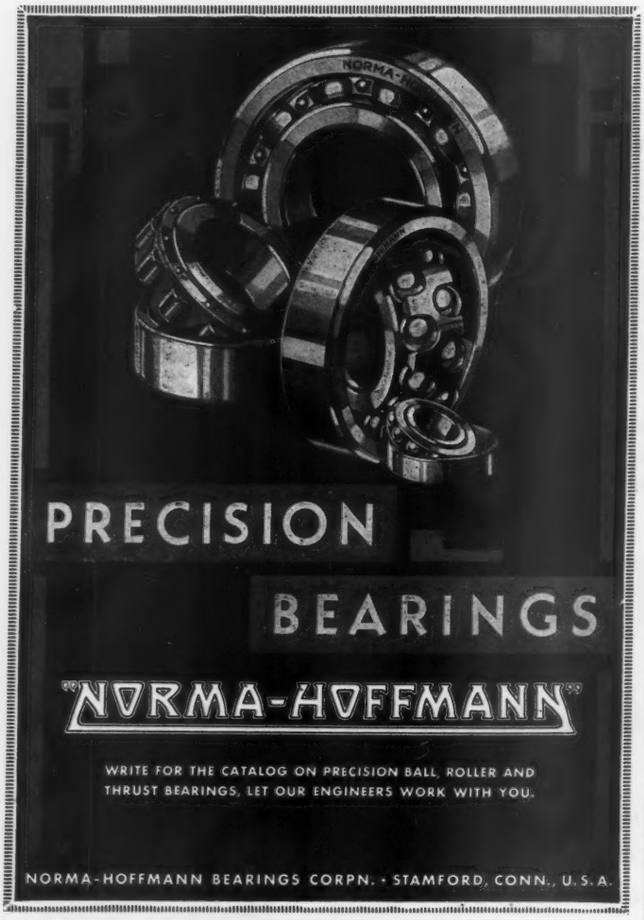
This Taylor Service is available to any plant—large or small. To get it, call in a Taylor Representative. Let him talk with your engineer—study your requirements—make his recommendations. Address, Taylor Instrument Companies, Rochester, N. Y.

Taylor

Indicating | Recording • Controlling

TEMPERATURE *and* PRESSURE INSTRUMENTS

The name Taylor now identifies our complete line of products, including Tycos instruments.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BEARINGS
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SCHIEREN-IZED
Schieren-izing is a process of tanning and finishing leather belting in such a way as to permit a new belt to grip the pulleys like one well broken in.
Chas. A. Schieren Company
Tanners and Manufacturers of Leather Belting, Packings and Specialties
72 FERRY STREET • NEW YORK

(Continued from page 34)

	Minutes per Unit
Scrubbing	
a. Clean cuspidor	1.40
b. Clean wash basin	2.73
c. Clean floor, linoleum	31.47 per 1000 sq.ft.
d. Clean door sill	1.17
e. Clean stair	0.12
f. Return cuspidor	0.56
Sweeping	
a. Empty paper basket	0.80
b. Remove cuspidor	0.56
c. Sweep bare floor	10.40 per 1000 sq.ft.
d. Sweep with hand vacuum cleaner	22.20 per 1000 sq.ft.
e. Oil-mop floor	8.40 per 1000 sq.ft.
Dusting	
a. Desk, plain top	0.41
b. Desk, glass top	0.83
c. Chair	0.12
d. File	0.05
e. Door	0.04
f. Window	0.15
g. Radiator	0.28

For scrubbing bare floors in textile plants and knitting mills, where the interference varies in the different departments, due to arrangement of machines, the standard times per 1,000 sq.ft. of surface scrubbed vary from 60.000 to 80.000 minutes.

For specific data as to standard times covering the cleaning of windows under varying conditions, the most practical information is contained in Management's Handbook, pages 1059 to 1065, inclusive. A more extended treatment of cleaning windows on standard times is contained in *Management Engineering,* Vol. 3, No. 1, July, 1922, pages 61-64.

In so far as glazing of windows as a building repair or maintenance operation is concerned, I do not have definite information of value separated from other work. There is no reason, however, why standard times cannot be applied successfully to this class of repetitive work, as they have been to many other maintenance operations.

It must be kept in mind that all of these standard times have been established to apply under specific operating conditions and if these conditions are not maintained it will be imposible to secure accomplishment of any tasks based upon their use. A check-up against local conditions is always in order before making any attempt to use them.

C. F. SCRIBNER
C. F. Scribner & Associates
Hendersonville, N. C.

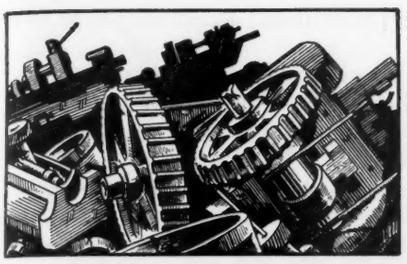
•

FACTORY FORUM . . .

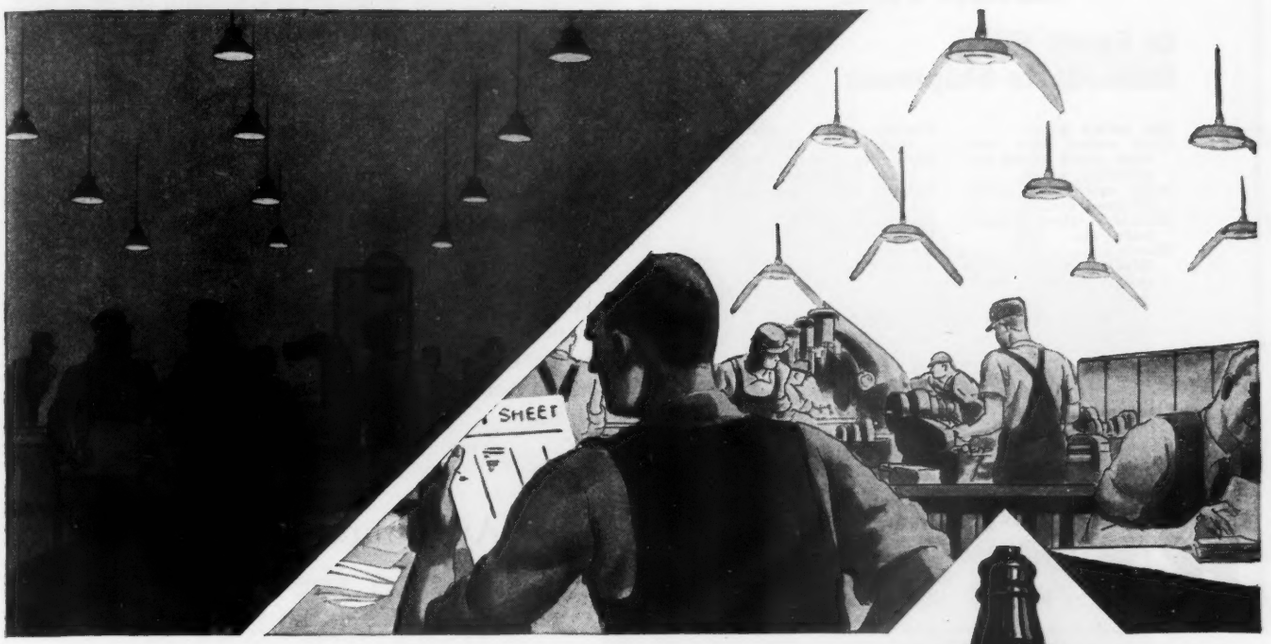
(Continued from editorial page 37)

fostered by a spirit of cooperation whose purpose is to aid both parties. During the course of his work an employee may discover better means of doing his work. Years ago it was often to his advantage to keep this to himself. Under the new system he can bring it to the attention of his employer through the works council with beneficial results to both parties.

Economic changes affecting the status of an enterprise can be freely discussed through works councils and em-



When a machine becomes obsolete, it goes to the scrap pile!



The Westinghouse RLM Reflector—its porcelain enamel surface has the highest reflection factor of all industrial fixtures.

LIGHTING, TOO, BECOMES OBSOLETE

WHEN machines become obsolete, sound economy dictates their replacement.

The same thing is true with your plant lighting. But—because of its insidious nature—obsolete, incorrect lighting so often goes unnoticed. Statistics show that in 87 per cent of the nation's industrial plants illumination is inadequate.

Time after time, scientifically correct lighting has proved to be a sound economy. In one plant it reduced the rejects per workman per week from 27 to 7; for another company it increased production 25 per cent per man; accident claims per year in a plant employing 1000 men have dropped from 425 to 170, saving more than $6,200 in compensation.

Why not check the lighting in your plant? Learn what economies improved illumination can effect for you. Call in a Westinghouse Lighting Specialist or one from your local power company who, without obligation, will make a careful study of your plant's lighting. With the new Light Meter he can accurately determine the right amount of illumination required in various locations where people work. If new fixtures are needed, be sure to specify Westinghouse reflectors and obtain maximum lighting effectiveness with the greatest economy.

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Like inventory shrinkage, its cost only appears when you search for it. Nevertheless, this waste always appears if you know where to search.

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2. Your factory burden, as overhead on electric wiring and equipment, and even as spoilage due to voltage fluctuation and consequent speed fluctuation of machinery.

That waste is entirely up to you. It can be avoided. Power factor correction equipment shows a net saving of between 50% and 150% of its cost per year.

We have prepared a simple exposition of this little known waste. With it you can probably estimate your present power losses and how they may be eliminated. Fill out coupon below, paste on penny post-card and mail to us. No obligation on your part, of course.

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Please send me your pamphlet on lower power factor waste and how to avoid it. I am interested in tracking down this unnoticed factory burden.

Name..... Position.....
Company .....
Address .....

ployer-employee relations adjusted accordingly from time to time.

Works councils can effectively discuss wages, hours, and working conditions if they recognize these facts:

1. Each man is worth only an amount proportional to his productive capacity.

2. Some classes of productive and non-productive work deserve a greater income than others.

3. Benefits may be attained only by rigorous and conscientious employer-employee cooperation, and it is occasionally necessary for one party or the other to make a temporary sacrifice.

On the other hand, the success of works councils will also depend on employers. They must recognize the fact that each employee is entitled to a fair return on his investment of time and labor just as they consider themselves entitled to a fair return on their capital investment.

Past labor troubles such as strikes, with accompanying absurd demands, lead one to the belief that works councils and unions cannot work side by side. Clearly, unions have shown their unwillingness for immediate cooperation to the same extent that sweat-shop employers have shown their lack of cooperative spirit. Works councils, working hand in glove with scientific management, are desirable.

CARL ENDLEIN, JR.
Endlein Engineering Corporation, New York

What Are Employees' Obligations Under the NIRA?

(Question presented in October issue)

THE IMPORTANCE of efficiency in business organization has never been so generally recognized as at the present time. Waste of all kinds must be eliminated and production per unit of cost must be increased. Employee efficiency and loyalty therefore count more than ever in the profitable operation of the concern.

Under the NIRA the employee has an added responsibility toward the firm. The employee has gained increased pay and fewer working hours. The employer is faced with higher operation costs. To offset these higher labor costs the worker must perform at top-notch efficiency. The loyal and worth-while employee is naturally anxious to help the firm keep its place in the business world and still operate under an increased labor cost. This employee recognizes that heavy payroll increases are involved and he will endeavor to raise his efficiency. He realizes that he too will receive benefits from shorter hours, the reemployment of other workers, and from the stabilized employment which will increase his earnings.

The employee should be eternally alert for errors and improvements, even though his own orders are restrictive. Cooperation means going out of one's way to aid the ultimate job.

HARRY KAUFMAN
Industrial Engineer, Philadelphia, Pa.

MOST employees give little or no thought to where the money for increases is coming from and care less. Those few that ask the question, "How is the company going to do it?" are the people that are really worth while in a plant. It is an easy matter to say we should be paid a certain wage, but thought must be given to the manufacturers' side of the question. Some indus-

Oxwelding helps « « «

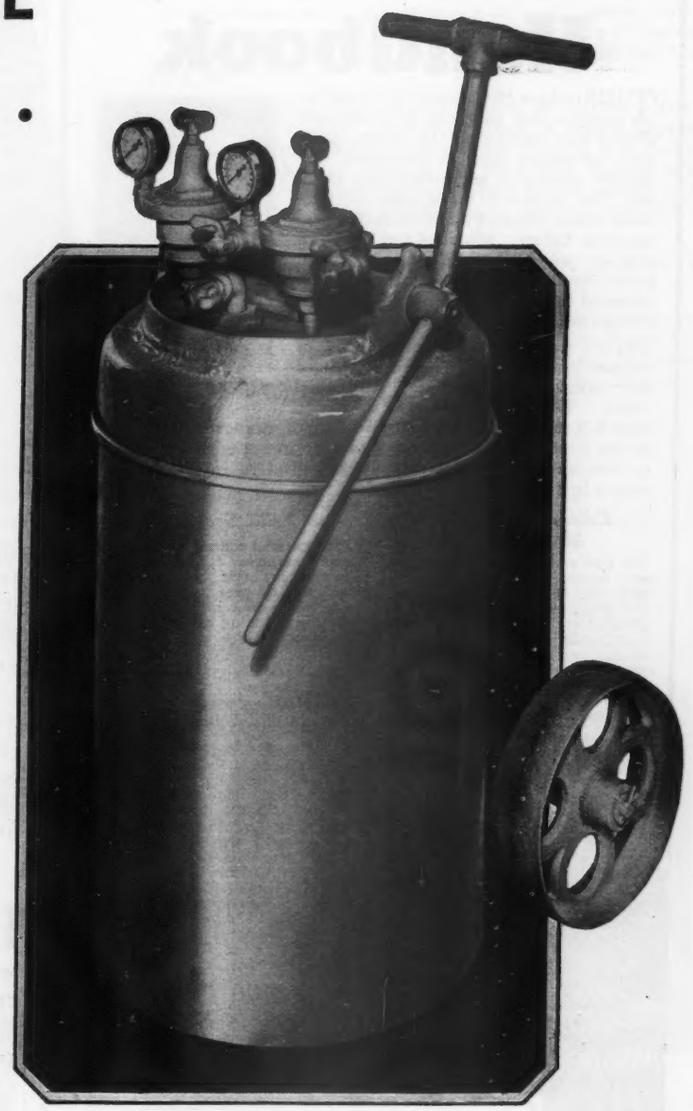
IN PROFITABLE REDESIGN.....

OXWELDING has enabled many manufacturers to turn out better metal products, often at lower cost, because it offers economies in production as well as complete freedom in design. Oxwelded joints assure the full rated strength of steel, or other materials. They can be made smooth and flush,—finishing is quicker and less expensive.

For instance:—A manufacturer of paint spraying equipment wanted a better joint for attaching chrome-molybdenum flanges to steel tanks. An oxy-acetylene welded joint proved more efficient and less costly.

But this was only a beginning. A Linde representative proposed redesign for welding,—relocating the cover flange joint to permit welding from the inside. This eliminated grinding which formerly was necessary prior to painting the tank. The use of a bronze welding rod, which was also suggested, required 17 minutes less welding time per tank and gave ample strength.

If you feel that redesign might improve your product, ask any Linde District Office how to obtain the full benefits of oxwelding and cutting. Write or 'phone, now.



Welding reduced the cost of the cover flange joint in this paint sprayer 68 per cent. Finishing costs were reduced approximately the same.

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L. P. ALFORD

Today, under current conditions of intense competition, everything turns on planned production and controlled costs. The executive who wants to take full advantage of the application of modern cost methods in the control and direction of production operations will find in this new Handbook exactly the kind of information for which he is looking.

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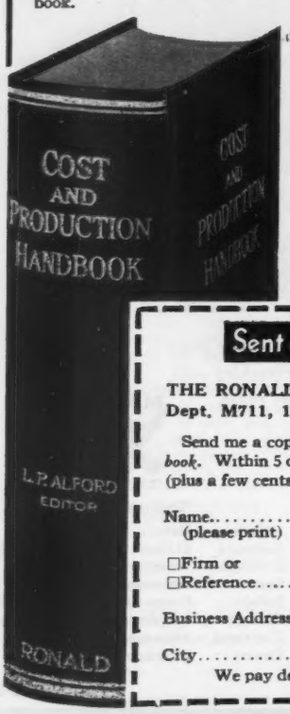
The *Cost and Production Handbook* was prepared under the editorial direction of L. P. Alford, M.E., Dr. Eng., as Editor-in-Chief. Associated with him as Contributing and Consulting Editors is a Board of 80 Authorities and Expert Specialists including executives of well-known manufacturing companies and outstanding professional consultants.

Nearly three hundred organizations supplied information regarding their methods and policies which is quoted in the pages of the Handbook.

28 Sections

The material contained in the *Cost and Production Handbook*, printed in ordinary style, would require 10 volumes of over 300 pages each. Its tremendous range is indicated by the following list of the 28 sections into which the Handbook is divided:

Statements and Reports. Production and Expense Budgets. Factory Organization. Measures of Factory Performance. Production Planning and Control. Simplification and Standardization. Purchasing. Raw Materials Estimating. Inventory Control and Storeskeeping. Job and Methods Standardization. Rate Setting. Incentive Plans. Timekeeping and Payroll Procedure. Buildings and Fixed Equipment. Machinery. Handling Materials. Plant and Service Costs. Cost Accounting Methods. Standard Costs. Cost Analysis. Depreciation and Obsolescence. Estimating Product Cost. Principles of Industrial Engineering. Labor. Operating Charts. Symbols and Classifications.



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tries cannot raise prices to compensate for the increases in wages asked for, and no manufacturer is going to run his business at a loss if he can help it—and rightly so.

This is just the trouble with the trade unions. The clause in the NIRA which says men may join organizations to bargain collectively has been taken to mean that manufacturers and industrialists must not oppose them in anything they demand. To date the strikes and unjust demands of some of the unions are killing the goose that lays the golden eggs; they are ruining all the good work the sponsors of NIRA are trying to create.

There is another picture that labor does not see and that is the increase in prices of everything they need. Every time wages are raised commodity prices go up. And who pays for this? If the worker does not buy, someone is thrown out of a job, so that all the worker gets out of it is a little more in his pay envelope and he must pay a great deal more for everything he buys.

In regard to employees striving to get out more work than they did before the depression, the only evidence of any additional effort is among piece workers. With the day workers we see very little evidence of any unusual activity; they require just as much supervision and must be jacked up just as much with the short day as in days gone by.

If employees would assume their obligations as outlined in any economy program they would strive to do more and better work, help eliminate unnecessary and spoiled work, take an interest in betterment methods, strive for greater safety among themselves, and so help their employers earn dividends with which to pay better wages. They would help the NRA do what it set out to accomplish, namely, give more work to more men and women and end the spectacle of millions out of work.

President Roosevelt should enter a clause in the NIRA codes that would eliminate strikes, which are undoing the good that the NRA is trying to accomplish. This could be done by demanding that all grievances must be submitted to a board of arbitration, their findings to be final.

WILLIAM C. BETZ, *Master Mechanic*
Fafnir Bearing Company, New Britain, Conn.

IN THE last analysis all are employees under an emergency act such as the NIRA—employers and workmen alike. Seeming sacrifices on both sides in reality assist all who partake. Here are five requirements that must be met by every employee if this act is to succeed:

1. Every worker must give his very best service, as to quality and quantity, in return for increased pay and shorter hours. If this is not done, commodity prices will advance out of all proportion.

2. Every employee must do his utmost to keep down costs, by his individual service as a worker and by recognizing his personal responsibility for carrying out principles of the code under which his employer is classed.

3. Loyal workmen will not fall prey to the tactics of agitators and those sponsoring undue strikes and walkouts when there is no justification for it.

4. The NIRA necessitates odd-shift schedules, particularly on maintenance, calling for hearty cooperation.

5. All, whether on wage or salary, must spend as much of increased earnings as practicable.

H. L. SCHULTZ, *Asst. Supt. of Maintenance*
The Carborundum Company, Niagara Falls, N. Y.

25,000

type-horsepower-speed combinations comprise Wagner's line of motors!

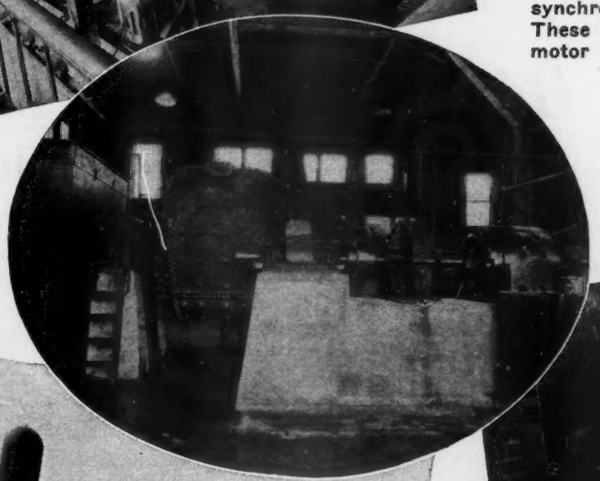
Singlephase or polyphase, squirrel-cage or slip-ring or synchronous, sleeve-bearing or ball-bearing, open or totally-enclosed, single-speed or multi-speed, horizontal or vertical—whatever the type or size of motor required, there's a Wagner motor ideally suited for the job.

The wide range of types and ratings of motors manufactured by Wagner is an assurance to motor buyers and users that Wagner recommendations are made without prejudice, that at no time will the wrong type of motor be supplied, and that entire plants can be correctly motored without delay and unreasonable expense.

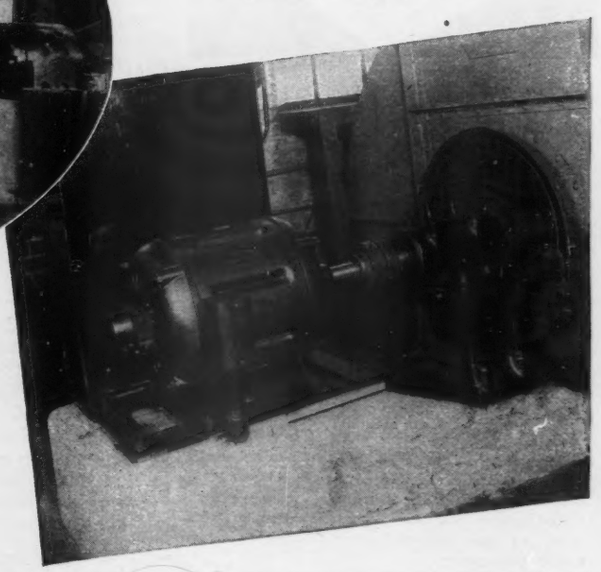
When motors are under consideration, consult Wagner.

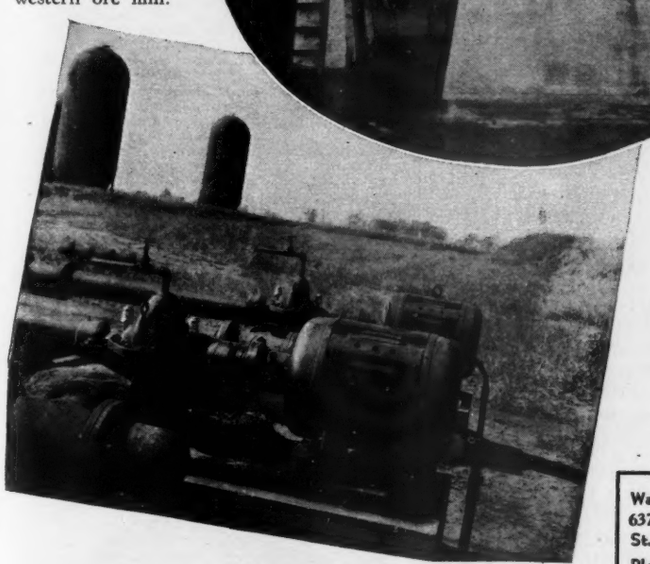
Ask for Wagner bulletin numbers 174 (squirrel-cage motors), 169 (slip-ring motors), 176 (Fynn-Weichsel synchronous motors), and 167 (fractional-hp motors). These four bulletins describe the entire Wagner motor line from 1/10 to 400 horsepower.

Above—Battery of 10-hp Wagner ball-bearing squirrel-cage motors mounted vertically, driving flotation machines in a large western ore mill.



At left, in oval—200 hp Wagner slip-ring motor operating a large ball mill.





Above—Two 40-hp Wagner CP totally-enclosed fan-cooled motors operating pipeline pumps.

At right (above coupon)—Wagner variable-torque multi-speed motor driving a forced-draft boiler fan. Motor has three speeds: 1750, 1160 and 870 rpm.

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- ☐ No. 169 Slip-Ring
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(Continued from editorial page 46)

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RUST PREVENTIVE—Booklet, "Proof of Results with No-Ox-Id in the Railroad Field."—Dearborn Chemical Co., Department G-1, 310 S. Michigan Ave., Chicago.

SWITCHES—Bulletin No. 10-A, "Diamond H Switches—Remote Control Equipment." —Hart Mfg. Co., Hartford, Conn.

WASH FOUNTAIN—Folder, A.I.A. File No. 29-H, "Washroom Economy and Sanitation."—Bradley Washfountain Co., 2203 Michigan St., Milwaukee, Wis.

WEIGHT RECORDERS—Catalog No. 1.32, "Weigh It Automatically." — Streeter Amet Co., 4101 Ravenswood Ave., Chicago.

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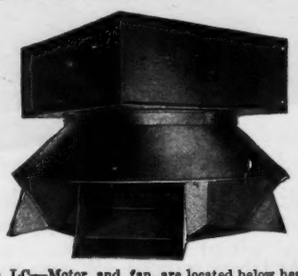

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